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目　次

水稻嘉農242號品種生態變異之初步調查……………………張萬來……1
水稻肥料分施與栽植密度對產量、產量構成因子及其他主要農藝性狀之效果……………………張萬來、楊遜謙……16
金門早生球莖甘藍種子大小試驗報告……………………李伯年……28
PCP鈣氰氮化鈣對水稻之肥效及除草效果試驗(第一報)……………………林國謙、溫西濱、王清演……32
種子殺菌劑處理對菜豆白絹病防除之效果……………………吳福壽……37
二化螟蟲之藥劑試驗……………………李淳陽、洪文堯……44
文献介紹……………………50

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本刊之英文名稱原爲「AGRICULTURAL RESEARCH」,自本期起改爲「JOURNAL OF TAIWAN AGRICULTURAL RESEARCH」,敬請讀者注意是幸。

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STUDIES ON THE IMPACT OF ENVIRONMENT ON THE CHARACTERS OF SEEDS AND THE SUBSEQUENT CROP OF THE RICE VARIETY CHIANUNG NO. 242*

by

W. L. CHANG**

INTRODUCTION

It has been the great concern for a breeder that a vareity released from his station will always maintain the same level of yielding ability at various places where it has been grown. Developmental variation, however, arises sometimes as a differential growth response in different environments. Under different soils and fertility conditions as well as different climatic conditions, a variety may behave quite differently. The occurrence of these variations through a period of time may be able to cause a great difference in the growth behavior and performance of a variety of the same origin.

Chianung No. 242 has been grown all over the island for years since it was released in 1954. There are complaints that this variety has already shown some kinds of deterioration. It is of great importance from the genecological standpoint to make sure that such variations really occurred and to determine whether these changes, if they do exist, are heritable.

Evidence is already at hand that environment can appreciably affect the quality of seed which in turn influences germination, growth, disease resistance, yield and other characters of succeeding crop. Actually, a concept has been prevailing that a certain place is paticularly suitable for producing high quality seeds for a specific crop.

This experiment was designed to (a) determine the type and nature of variation which might occur to the variety grown at various places and (b) measure the effect of source of seed on productivity and other related characters.

REVIEW OF THE LITERATURE

Kanda *et al.* (1952) reviewed the literature rather completely and found that individuals within a given variety of rice could behave quite differently in their phenotypes under various environments. Some of these ecological variations appeared to have genetical basis, even though most of these environmental variations were not heritable.

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Sakai (1954) estimated that a line or variety of rice is still heterozygous for almost 20% of genes controlling grain yield if it is assumed that genic pairs involved in the expression of yielding ability are around 50 and the line or variety is established at F9. In the first few generations after this line or variety is released, many of these minor genotypic variations may be lost because of selective elimination by the environment (Eliiott, 1958). Adair and Jones (1946) found that the desired combinations of agronomic characters survived in the bulk hybrid populations grown under different environmental conditions.

Noguchi (1958) reported to have successfully induced mutations from rice plants continuously grown under the condition of complete phosphorus deficiency. The mutability of plants was also reported to be greatly increased by keeping plants under the conditions of nitrogen and sulphur deficiency. Matsuo *et al.* (1959) also observed some variations on rice plants treated with nitrogen and phosphorus deficiency. However, these variations were later proved to be merely the after-effects of abnormal environments.

The Environment under which seeds are produced affects the growth of the succeeding crop. Nagai (1959) listed five factors which he regarded to be significantly related to the establishment of ecotypes and forms of rice. They are: (1) water requirement, (2) temperature, (3) the length of day during the growing season, (4) soil fertility and (5) salinity of soil and water. Matsuo *et al.* (1959) reported a significant influence of nutrients in rice; Went (1959), that of temperature in potato; Yamamoto and Wuematsu (1958), soil texture in carrot; Togari *et al.* (1954), soil fertility in soybean and Johnson (1954) observed the influence of light intensity in wheat.

The effects of seed quality on yield and other agronomic characters of the resulting crop were observed in rice (Tomo, 1951; Kanda *et al.*, 1952; Kido *et al.*, 1954; Matsuo *et al.*, 1956). in wheat (Waldron, 1941; Quinby *et al.*, 1962), in oat (Frey and Wiggans, 1956), in soybean (Suetsugu and Anaguchi, 1953; Ikeda, 1955), in potato (Went, 1959), in birdsfoot trefoil (Henson and Tayman, 1961), in Kentucky blue grass (Frakes, 1961) and in carrot (Yamamoto and Wuematsu, 1958). Generally, there was a correlation between large heavy seeds and high yields of the subsequent crop. Matsuo *et al.* (1956) found a significant difference in yield of individual progeny of large and small seeds in rice; but when the same weight of seed was planted, the difference tended to disappear.

Time of flowering in soybean (Ikeda, 1955) and heading date in rice (Kayama, 1953) were significantly affected by different sources of seeds. Tomo (1951) reported that significant differences occurred in the length of grain among different sources of seeds.

Quinby *et al.* (1962) reviewed the literature on the effect of source of seed to the resistance of disease and found that smut infection in oat and wheat was influenced by the environmental conditions to which the seed was exposed during the previous growing season. Suneson and Peltier (1936) found highly significant

winter hardiness differences within the same variety when different sources of seed were compared. Yamaguchi (1956) observed a difference in X-ray susceptibility among seeds of different sources of the same variety and attributed it to the change in physiological property of the seed.

MATERIALS AND METHODS

Seeds of Chianung No. 242, a Japonica variety of rice developed at this station were collected from various places where it had been growing for years. The seeds were sampled from the direct descendants of the original stock which came from this station. Attention was paid in sampling so that the sample in all could cover a wide range of environment. The sample thus collected was coded and the code number, source, history and environmental conditions of each sample are listed in table 1.

Table 1. Source, history and environmental conditions of samples collected.

Code No.	Source			Classes of seed	Original introduction		Soil texture	Soil fertility	Topography
	Region	Prefecture (City)	County		Year	Crop.			
1	Hsinchu	Hsinchu	—	foundation	1956	2nd.	loam	fertile	plain
2	Hsinchu	Hsinchu	Kuonlin	farmer's	1956	1st.	loam	moderately fertile	valley
3	Taichung	Taichung	—	foundation	1958	1st.	clay	mod. fertile	plain
4	Taichung	Nantou	Chusan	farmer's	1957	2nd.	clay loam	mod. fertile	valley
5	Taichung	Nantou	Chusan	farmer's	1959	2nd.	sandy loam	mod. fertile	valley
6	Taichung	Nantou	Puli	farmer's	1958	2nd.	loam	mod. fertile	valley
7	Taichung	Tsanghua	Tatsuan	farmer's	1956	2nd.	sandy loam	mod. fertile	plain
8	Taichung	Tsanghua	Fuenwen	farmer's	1958	2nd.	sandy loam	mod. fertile	plain
9	Taichung	Tsanghua	Shichou	farmer's	1959	1st.	sandy loam	mod. fertile	plain
10	Tainan	Chiayi	—	breeder*	1954	1st.	clay loam	fertile	hillside
11	Tainan	Chiayi	Chiayi	farmer's	1959	1st.	loam	mod. fertile	plain
12	Tainan	Chiayi	—	fundation	1959	1st.	loam	mod. fertile	plain
13	Tainan	Tainan	Iuchen	farmer's	1957	1st.	loam	mod. fertile	valley
14	Kaohsiung	Kaohsiung	Chochen	registered	1960	2nd.	loam	mod. fertile	seaside
15	Kaohsiung	Kaohsiung	Sinen	farmer's	1960	1st.	loam	mod. fertile	plain
16	Kaohsiung	Kaohsiung	Nito	farmer's	1960	2nd.	sandy loam	mod. fertile	seaside
17	Kaohsiung	Pinton	Nanchou	farmer's	1959	2nd.	sandy loam	fertile	plain
18	Kaohsiung	Pinton	Likan	farmer's	1960	2nd.	sandy loam	fertile	plain
19	Kaohsiung	Pinton	Wantan	farmer's	1960	2nd.	clay loam	fertile	plain
20	Taitung	Taitung	Tsusan	farmer's	1955	2nd.	clay loam	fertile	plain
21	Taitung	Taitung	—	foundation	1960	2nd.	sandy loam	mod. fertile	plain
22	Hualiem	Hualien	—	foundation	1961	1st.	sandy loam	mod. fertile	plain
23	Hualiem	Hualien	Luesuei	farmer's	1958	1st.	sandy loam	mod. fertile	plain
24	Kaohsiung	Pinton	Neipu	farmer's	1960	1st.	sandy loam	mod. fertile	plain
25	Taipei	Ilan	Sansin	farmer's	1961	1st.	loam	mod. fertile	valley

* Original stock used here as check.

Seeds from each sample were measured for weight of 1,000 grains, length, width and thickness of grain, germination percentage and rate before planting. On the day before transplanting, seedling length, width and number of leaves and number of lesions of rice blast disease on each seedling were recorded. Natural epiphytotic for rice blast disease was available during the early stage of growth, hence the percentage of the disease was taken for each sample at 35 days after transplanting. At the full ripe stage, plant height and number of panicles were recorded. Before harvesting, ten ears, each from one hill, were sampled and the following data collected: length, weight and number of grains per ear, length, width and thickness of grains and the weight of 1,000 grains. Grain yield was based on the total grain yield of each plot.

All data collected were subjected to the analysis of variance. Square root and arcsin transformations were made for the data of the number of lesions and percentage of blast disease respectively, before making the analysis, according to the method shown by Snedecor (1961).

Two treatments were included in this experiment: fertility and source of seed. With and without fertilizations were two levels of fertility treatment while 25 samples constituted source of seed. The amount of fertilizers used in fertilization treatment was 80, 40, 40 kilograms per hectare for N, P and K respectively. The experiment was arranged in a split-plot design with two levels of fertilization as the main plots on 4 replications and 25 samples as the sub-plots.

Each sample was planted in 4-row plot which was equivalent to 1/2,500 hectare. The distance between rows was 25 cm and the distance between hills within a row was 20 cm. Approximately five seedlings were planted in each hill.

This experiment was conducted on the second crop of 1963 at Chiayi Agricultural Experiment Station. It was seeded on July 20, transplanted on August 1 and harvested on November 26. Standard method of rice culture was followed during the growing period.

EXPERIMENTAL RESULTS

Influence of Environment on the Characters of Seed.

The means and F values from analysis of variance for characters of seed measured are summarized in table 2.

The analysis of variance showed highly significant differences among sources of seed in length, width and thickness of grains as well as weight of 1,000 grains. Apparently, the quality of seed was appreciably influenced by the environment to which the seed was subjected during its development. It was found that changes among three components of grain size i. e. grain length, width and thickness were not necessarily parallel among themselves. Lighter grains were shown to be generally related to smaller size of seed. However, no close association seemed to exist between size and weight in heavier grains. Among components of grain size,

Table 2. Average values for morphological and physiological characters of different sources of seed.

Code number of sources	Grain Length (mm)	Grain Width (mm)	Grain Thickness (mm)	Weight of 1,000 grains (g)	Germination (%) Percentage	Germination (%) Rate
1	0.708	0.309	0.183	23.80	97	86
2	0.723	0.327	0.225	31.12	90	18
3	0.722	0.317	0.188	27.02	95	78
4	0.717	0.324	0.194	29.51	98	70
5	0.714	0.321	0.203	29.80	94	72
6	0.721	0.316	0.191	27.70	99	61
7	0.721	0.321	0.200	24.58	100	76
8	0.738	0.332	0.185	27.48	97	86
9	0.710	0.318	0.186	28.46	99	82
10	0.712	0.335	0.197	29.72	100	53
11	0.726	0.322	0.226	28.54	96	68
12	0.731	0.318	0.189	26.39	93	81
13	0.722	0.317	0.188	28.01	96	83
14	0.731	0.324	0.194	27.30	100	96
15	0.730	0.321	0.194	27.66	100	98
16	0.723	0.317	0.192	27.11	100	98
17	0.710	0.325	0.206	27.12	98	96
18	0.717	0.307	0.190	27.60	100	94
19	0.724	0.321	0.191	26.84	99	99
20	0.720	0.315	0.212	27.64	74	6
21	0.710	0.321	0.218	29.94	95	79
22	0.724	0.319	0.215	29.10	98	25
23	0.717	0.314	0.219	27.40	95	13
24	0.716	0.313	0.215	27.31	98	61
25	0.728	0.330	0.220	30.16	100	78
Mean	0.720	0.320	0.201	27.89		
F value	4.83**	11.08**	36.62**	165.66**		
L.S.D. 1%	0.013	0.007	0.008	0.469		

** F value significant at 1% level.

width and thickness of seed appeared to be more variable than grain length, as indicated by larger F values associated with the former two characters than that of the latter. It was also revealed in the data that the former two components of seed size were more related to the weight of seeds.

Differences in both percentage and rate of germination were also indicated. The rate of germination was more variable than percentage of germination, suggesting that the former was more easily affected by the environment. The rate of germination also varied in samples with same total germination percentage.

Influence of Sources of Seed on the Characters of their Seedlings.

A summary of the data obtained from the measurements of seedling appears in table 3.

Highly significant differences occurred among sources of seed in all characters of the seedlings measured, indicating that sources of seed could considerably change the characters of seedlings. Within a sample, all characters of seedlings seemed to be well coordinated among themselves in their respective growth which even-

Table 3. Means and F values for the characters of seedlings resulted from different sources of seed.

Code number	Leaf		Length of seedling (cm)	No. of lesions of blast diseae on leaves
	Number	Width (cm)		
1	5.10	0.47	23.02	1.28
2	5.00	0.45	23.48	7.24
3	4.70	0.40	21.24	2.35
4	4.70	0.41	22.05	2.53
5	4.30	0.35	20.21	0.51
6	4.10	0.31	15.97	0.25
7	4.50	0.41	19.26	0.28
8	4.60	0.40	20.65	0.59
9	4.40	0.39	20.93	0.37
10	4.55	0.36	19.48	0.69
11	5.00	0.48	22.48	0.56
12	4.85	0.41	20.05	0.28
13	4.80	0.41	21.68	0.64
14	4.30	0.35	20.50	0.25
15	3.90	0.38	22.26	0.08
16	4.70	0.44	20.26	1.07
17	4.10	0.37	20.82	0.23
18	4.55	0.39	18.94	0.51
19	4.40	0.34	18.61	0.19
20	4.15	0.38	21.82	0.61
21	3.40	0.38	19.18	0.35
22	3.80	0.42	19.84	0.66
23	3.90	0.38	23.13	1.04
24	3.30	0.46	18.71	0.04
25	3.90	0.39	20.02	0.23
Mean	4.36	0.40	20.58	0.77
F value	16.40**	2.62**	14.60**	16.80**
L.S.D. 1%	0.43	0.09	0.52	0.34

** F value significant at 1% level.

tually resulted in the significant difference of seedling growth. The height and number of seedlings were more variable than width of leaves. In general, sample No. 1 showed the best growth of seedlings while sample No. 6, the poorest.

The average counting of rice blast lesions per leaf ranged from a minimum of 0.04 lesion per leaf in sample No. 24 to a maximum of 7.24 lesions in sample No. 2, a difference which greatly exceeded the 1% level of significance. It was apparent that the number of lesions on leaves was not related to the growth of seedlings.

Influence of Sources of Seed on the Growth of the Succeeding Crop.

A number of important characters were measured during the growing period of rice plants. A summary of the data appears in table 4, while the F values obtained from the analysis of variance are presented in table 5.

Table 4 shows that rice blast infection of plants as indicated by the percentage of blasted leaf area ranged from 6.5% to 16.8% which fell under class 3 or "moderately susceptible" group according to the standard of classification currently employed by rice investigators. The difference among samples just failed to reach significance at the 5% level of probability. The rice blast infection was relatively light in the plots of no fertilization but it was heavier in the fertilized plots. The difference between fertilizations, however, was not significant.

Differences in plant height at 40 days after transplanting and full mature were significant at the 5% and 1% levels of probability, respectively. Plant height in sample No. 6 was the shortest at both stages, indicating a consistant change of this character through the whole period of growth. Fertilizations did not cause significant change of plant height among sources of seed at both stages.

A difference of 3 days in heading date as expressed by the number of days from transplanting to heading was observed among sources of seed. The differences was significant at the 1% level of probability. Heading date was also significantly delayed in the fertilized plots. The number of tillers per hill differed significantly among samples as well as between fertilizations. F value associated with difference between fertilizations was extremely large, indicating that this character was very sensitive to the environment. Highly significant differences occurred in both length and weight of panicles among samples. The weight of panicles seemed to be more variable than the length of panicles since F value associated with the former character was larger than that of the latter. It should be noted that fertilizations did not cause significant changes in these two characters of panicles.

No significant interaction between source of seed and fertilizations was observed in the characters listed in Table 4.

Effect of Sources of Seed on Yield, Components of Yield and Size of Seeds of the Subsequent Crop.

The average yield, components of yield and size of seed were recorded on the crop resulted from different sources of seed. The data are summarized in Table 6, while a summary of F values computed from these characters appears in Table 7.

Table 4. Average values of some agronomic characters of plants grown from different sources of seed.

Code number	Rice blast (%)	Plant height (cm) 40 days	Plant height (cm) Full mature	Heading date	Number of tillers per hill	Panicle length (cm)	Panicle weight (g)
1	11.5	83.2	110.0	57.6	10.3	24.3	5.3
2	12.6	77.2	108.6	57.8	10.4	23.0	4.9
3	14.4	82.0	110.9	57.9	10.4	23.7	5.0
4	14.6	78.0	110.1	58.5	10.8	23.3	4.8
5	16.8	79.9	110.2	57.6	10.8	23.7	4.9
6	12.9	75.6	104.2	59.0	10.7	21.5	4.7
7	10.6	81.4	110.1	55.6	11.8	23.5	4.9
8	11.0	78.7	108.2	58.0	10.8	23.0	4.8
9	12.5	80.3	109.8	57.8	10.5	23.6	5.1
10	14.1	80.8	111.7	58.9	10.5	24.1	5.1
11	13.1	84.4	111.9	57.4	10.7	23.8	5.1
12	15.1	81.1	111.8	57.9	10.3	23.8	5.0
13	16.1	82.8	110.1	57.4	11.6	23.9	5.3
14	13.6	82.1	112.7	58.0	10.8	23.8	4.9
15	6.5	82.2	109.0	58.9	12.6	22.9	4.6
16	10.4	80.5	110.5	58.6	11.5	23.0	4.7
17	9.6	81.1	108.4	57.6	11.5	22.8	4.0
18	14.1	80.5	110.6	58.0	10.6	23.9	5.1
19	10.3	81.6	111.8	58.4	10.7	23.8	5.1
20	10.3	82.1	110.7	58.1	10.7	23.2	5.0
21	13.0	79.0	109.8	58.0	10.3	23.2	4.9
22	12.3	80.0	108.8	58.0	10.4	23.1	5.0
23	11.8	80.9	109.3	56.9	9.6	23.9	5.2
24	14.0	80.3	111.5	58.6	9.9	23.1	4.8
25	13.4	79.4	109.4	58.4	10.3	23.9	5.1
Mean	12.5	80.7	110.4	58.0	10.7	23.4	4.9
L.S.D. 5%	—	3.6	2.5	1.1	1.1	1.4	0.4

Table 5. F values for comparisons of samples, fertilizations and interaction.

Source of variation	Rice blast infection	Plant height 40 days	Plant height Full mature	Heading date	Number of tillers per hill	Panicle length	Panicle weight
Samples	1.34	1.88*	3.62**	3.53**	2.72**	2.75**	3.41**
Fertilizations	9.65	1.41	7.25	25.89*	661.54**	0.04	4.04
S × F	1.33	0.78	0.99	0.51	0.86	0.82	1.38

* Significance exceeds 5% level of probability.

** Significance exceeds 1% level of probability.

Table 6. Average yield, components of yield, and size of seeds of rice plants grown from different sources of seed.

Code number	Grain yield (kg/ha)	Number of panicles per hill	Number of grains per head	Weight of 1,000 grains (g)	Size of grain		
					Length (mm)	Width (mm)	Thickness (mm)
1	4,755	9.5	172.0	31.3	0.724	0.309	0.208
2	4,160	9.4	161.6	30.2	0.717	0.309	0.209
3	4,430	9.6	161.6	30.1	0.720	0.308	0.206
4	4,293	9.5	163.7	28.2	0.719	0.307	0.207
5	4,143	10.0	159.1	30.2	0.720	0.309	0.205
6	3,950	9.5	153.0	29.1	0.711	0.301	0.206
7	4,273	10.2	161.5	29.8	0.728	0.310	0.210
8	4,138	10.3	155.0	29.8	0.719	0.309	0.206
9	4,158	9.8	165.1	30.3	0.720	0.309	0.210
10	4,208	9.5	162.7	29.8	0.715	0.304	0.208
11	4,445	9.8	169.7	29.7	0.721	0.309	0.208
12	4,260	9.7	169.5	29.3	0.715	0.307	0.208
13	4,435	10.4	171.4	30.0	0.721	0.309	0.210
14	4,333	10.0	165.9	29.2	0.723	0.308	0.209
15	4,213	9.5	153.8	29.0	0.723	0.306	0.210
16	4,105	10.5	160.7	29.2	0.718	0.307	0.205
17	4,358	10.7	144.4	28.3	0.711	0.305	0.205
18	4,265	9.9	166.9	29.9	0.718	0.306	0.208
19	4,140	9.8	170.5	29.3	0.715	0.306	0.204
20	4,363	9.5	165.1	29.4	0.713	0.310	0.209
21	4,230	9.5	162.3	29.9	0.717	0.306	0.207
22	4,140	9.1	161.6	29.6	0.722	0.308	0.206
23	4,570	9.0	164.4	30.9	0.725	0.308	0.212
24	4,208	9.7	158.3	29.5	0.721	0.308	0.208
25	4,348	9.7	164.4	30.3	0.717	0.304	0.206
Average	4,272	9.8	160.2	29.7	0.719	0.307	0.207
L.S.D. 5%	—	0.9	7.8	1.5	—	—	—

Table 7. Summary of F values for yield, components of yield and size of seeds.

Source of variation	Grain yield	Number of panicles per hill	Number of grains per head	Weight of 1,000 grains	Length of grain	Width of grain	Thickness of grain
Samples	1.47	1.61*	5.18**	1.69*	1.01	0.82	0.97
Fertilization	2.79	94.74**	6.45	0.52	0.23	0.27	8.25
S × F	1.11	1.29	2.51**	0.84	1.36	1.64	1.17

* Significance exceeds 5% level of probability.

** Significance exceeds 1% level of probability.

Table 7 shows that sources of seed did not cause a significant change in yield, although significant differences occurred in the three components of yield. Differences between fertilizations were not significant in yield and two components of yield i. e. the number of grains per head and the weight of 1,000 grains, while in another component of yield, the number of panicles per hill, the difference between fertilizations was highly significant, indicating that this character was very susceptible to the change of the environment. The interaction between sources of seed and fertilizations was highly significant in the number of grains per head. However, the interactions between the treatments were not significant in yield and the other two components of yield, namely the number of panicles per hill and the weight of 1,000 grains.

The length, width and thickness of grains were not significantly affected by sources of seed and fertilizations, although F value associated with the difference between fertilizations in the thickness of grains was considerably large. No significant interaction between the treatments was also evident in these three characters.

DISCUSSION AND CONCLUSIONS

It was observed that seeds taken from various parts of the island differed significantly in their morphological characters. This may be due largely to the difference in environment of the sampling places. Differences in environment at sampling places are quite great as one might suppose from the geographical locations. The extreme temperature and monthly mean length of day in hours differences are 5.1°C and 120 hours respectively in February and 4.2°C and 78.1 hours respectively in July. The patterns of change, however, are similar in both temperature and day length. Altitude and topography also vary considerably from mountaneous valleys to coastal plains, but variations in soil texture and soil fertility are rather small.

Seedlings, components of yield and several agronomic characters of rice plants were significantly affected by sources of seed, indicating that the environment under which seeds are produced affects the growth of plants that grow from them. The lighter seeds of sample No. 6 taken from Puli, Nantou prefecture gave the poorest growth of seedlings while the heaviest seed of sample No. 2 from Kuonlin, Hsinchu prefecture produced the best established seedlings, suggesting that the weight of 1,000 grains might be related to the growth of plants. Suetsugu and Anaguchi (1953) observed in soybean that the after-effects of seed was due primarily to the weight of seed. Kayama (1953) and Matsuo *et al.* (1956) also reported that large and heavy seeds of rice generally led to the production of well established seedlings. It is understandable that a heavier seed produces a better seedling since it may store more nutrients. Frey and Wiggans (1956) actually observed in oat that this initial "capital" has an effect upon the growth of seedling produced. It should be noted, however, that the lightest seeds of sample No. 1 from Hsinchu Agricultural

improvement Station produced well grown seedlings. This may suggest that inner property of seed has been changed by the environment and this physiological response of seed which is not yet understood may also affect the growth of plants grown from different sources of seed. Quinby *et al.* (1962) reported that plants grown from the lightest seeds were not unusually low in production. Matsuo *et al.* (1956) suggested that activity of enzymes may be involved in the inner change of seed. Based on these observations, it seems logical to conclude that the environment changes not only morphological characters, but also physiological activities of seed and these changes of seed are equally important in their influence on the growth of plants.

It was clearly indicated that the growth of seedling was related to the growth of rice plants and grain yield. Seedlings of sample No. 6 which showed the poorest growth were also found to grow poorly in the paddy field and produced the lowest yield, while the best grown seedlings of sample No. 1 grew well in the field and gave the highest yield. Matsuwura (1948) also reported a similar case in rice that well established seedlings could increase yield from 21% up to 61%.

Differences in rice plants among sources of seed were highly significant for most of the characters measured. The results seem to indicate that these differences may not be entirely environmental fluctuations but may possibly include certain genotypic variations. From the genetical standpoint, a variety may not be completely homozygous for all pairs of genes it contains. It is theoretically possible that when a given variety is released, there still remains some minor genetic variation, even though obvious segregation is essentially complete. Chianung No. 242 has been grown for years under various environmental conditions which provide many types of ecological situations and condition of partial isolation. Therefore, it seems probable that certain minor genetic variations may be fixed or lost because of differential selection of the particular environment where the variety happens to grow. It is possible that different sources of seed tested in this experiment may have different genotypes for certain characters. This possibility was also discussed by Sakai (1954) and Elliott (1958), and some genetical variations were actually reported by Noguchi (1958) and Matsuo *et al.* (1959). However, it is still unknown whether variations among sources of seed observed in this experiment are heritable or non-heritable. Further investigation will be conducted to make this point clear.

Differences between fertilized and non-fertilized plots for each sample were not significant in most characters of the plant except heading date and number of tillers per hill. These observations seem to indicate that each sample of seed in itself may be quite stable and less variable as compared with the variation among sources of seed. The great variability of heading date and number of tillers per hill caused by fertilizations is not unexpected.

Difference in grain yield among sources of seed was not significant, indicating that after-effects of seed was not effective to change yielding ability of rice plant.

This result was similar to those reported by Kanda *et al.* (1952) and Matsuo *et al.* (1956). Nevertheless, 805 kg per hectare or nearly 20% yield difference still occurred between the highest and the lowest samples. Since grain yield is a quantitative character which depends upon the composite activity of multiple genes, and, as estimated by Sakai (1954) that a given variety is still heterozygous for a number of genes controlling grain yield, it seems reasonable to suspect that samples of seed may differ in their genetic constitutions. However, the difference in the genic formula may be of such a small magnitude to be of any significance. Therefore, it seems probable that Chianung No. 242 currently under cultivation at various parts of the island may still maintain a same level of productivity.

It is of interest to note that highly significant differences observed in components of yield did not lead to a significant difference in grain yield. The result may be explained that three components of yield may change in different directions in each sample, so that the positive effect brought about by one component of yield may be nullified by the negetive effect of another component of yield. As a result, the yield difference among samples may be considerably minimized.

Seeds from fertile plain were generally more productive than those from high altitude valley as reported by Matsuo *et al.* (1956). Since difference in yield among sources of seed was not significant, it would appear dangerous to assume that Hsinchu Agricultural Improvement Station was a better source of seed for Chianung No. 242 than Puli and elsewhere. Furthermore, it is still not known that high yielding ability of seeds from Hsinchu Station was caused by the morphological and physiological changes of seed or by genotypic variations of seed.

The average yield of six foundation seed samples from local Agricultural Improvement Stations was 4,337 kg per hectare while that of 19 samples from farmers was 4,258 kg per hectare. Although the difference was small, the importance of cultural techniques other than the environment involved in the quality of seed should be noted. In general, seeds from farmers were undesirable because of their high percentage of off-types.

The difference in rice blast susceptibility among sources of seed was not significant, indicating that Chianung No. 242 now growing at various parts of the island may have a same degree of resistance to rice blast disease. The average percentage of infection in seed samples from valleys was 14.4%, while that of samples from plains was 11.9%, with a difference of 2.5%. What caused the difference is not obvious. However, seeds produced at cool high altitude valleys seem to be less resistant to rice blast disease.

It was found that differences in length, width and thickness of grains were highly significant among sources of seed. However, when plants grown from these seeds were harvested and their grains measured, no difference was detected on these three characters. A conclusion seems to be reached, therefore, that variations caused by the environment on these three morphological characters of seed were

non-heritable and after-effects of the environment on these characters could not affect the next generation.

SUMMARY

Seeds of rice variety Chianung No. 242 were sampled from various places of the island and the data on characters of particular importance were taken from sampled seed, nursery, paddy field and harvested grains to measure the variations among samples and the effect of sources of seed on the succeeding crop. A total of 25 samples were compared on non-fertilized and fertilized plots with 4 replications arranged in split-plot design with two fertilizations as main plots and 25 samples as sub-plots. The experiment was carried out at Chiayi Agricultural Experiment Station on the second crop of 1963.

Seeds produced at different places were significantly different in morphological characters and there were some indications that certain physiological changes might also have taken place in different sources of seed. Differences in morphological characters of length, width and thickness of seeds disappeared after one crop cultivation at this station, but difference in weight of 1,000 grains still remained significant. The differences in the former three characters of seeds appear to be the environmental fluctuation which does not affect the next generation.

Statistically significant differences in seedlings, components of yield and most of the agronomic characters of rice plants grown from different sources of seed were obtained. The differences in these characters possibly include the after-effects of the environment during seed formation and genetical variations resulted from differential selection of the particular environment where the variety happens to grow. However, what actually caused the differences is not obvious.

Grain yield was not significantly affected by different sources of seed, suggesting that Chianung No. 242 now widely grown at various parts of the island may still have a same level of productivity. A tendency seemed to prevail for the foundation seeds to yield better than the seeds produced by farmers. It is still not clearly known that a given place was a better source of seed for this variety.

No significant difference in rice blast susceptibility was evident, indicating that Chianung No. 242 now under cultivation in Taiwan may still maintain the same degree of resistance to rice blast disease. However, seeds produced at cool, high altitude valleys seemed to be less resistant to this disease than those produced at coastal plains.

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水稻嘉農 242 號品種生態變異之初步調查

張 萬 來

摘 要

本試驗以探究水稻嘉農 242 號品種在各推廣區域有否因受自然環境，耕種制度以及栽培年代之不同而發生之變異為目的，試驗分室內及田間兩方面進行，調查由全省各地收集該品種25個樣谷之各種有關性狀。田間試驗採裂區設計，以不施肥及標準施肥為主區，25個樣谷為副區，重複四次，本試驗於民國52年第 2 期作在嘉義農業試驗分所舉行，玆將所得結果摘要如下：

由不同地區，所得之嘉農 242 號品種間，其谷粒之粒長、粒幅、粒厚及千粒重，差異均極為顯著。且發芽率及發芽勢亦有差異。粒長、粒幅、粒厚之差異在本分所經過一期作之後即見消失。故其變異原因似為環境之影響，非屬遺傳性變異。

地區不同之嘉農 242 號品種，在秧苗，稻株各農藝性狀，均有顯著之差異存在。此種變異，可能包括由環境獲得之後作用及因環境而形成之遺傳變異，惟眞正變異原因，尙待查明。

不同地區之嘉農 242 號品種，其產量並無顯著之差異。由此推測，目前在本省各地栽培之嘉農 242 號品種猶有相等之生產力，就本試驗所得結果尙難確定某一地區較適合繁殖高生產力之稻種。

本試驗生育初期普遍發生稻熱病。在不同地區所得嘉農 242 號品種間，其葉稻熱病罹病率之差異不顯著。由此言喻，本省各地正在推廣之嘉農 242 號品種，對葉稻熱病似仍具有相同程度之抵抗力，但高海拔地區生產之稻種，其後代之抗病性似較平地生產者為弱。

EFFECTS OF SPLIT APPLICATION OF FERTILIZER AND PLANTING DENSITY ON YIELD, COMPONENTS OF YIELD AND OTHER AGRONOMIC CHARACTERS OF RICE

by

W. L. CHANG and S. C. YANG*

INTRODUCTION

Fertilization of rice in Taiwan is generally based on a well established practice of applying the total amount of phosphate, potash and half of nitrogen fertilizers as a basal dressing and the balance of nitrogen as a top-dressing at the time of second weeding. This method of fertilization usually stimulates vigorous vegetative growth of rice at the early stage of growth, especially under tropical environmental conditions which favor an early establishment of vegetative parts of rice. The growth, however, is considerably depressed at the later stage. This type of growth is considered as one of the reasons that causes lower yield in the tropical area. Furthermore, the failure of crop due to lodging and prevalence of rice blast disease may also be related in one way or another to the conventional method of fertilizer application.

Although a considerable work has been done regarding the nutrient requirements of rice, only limited data are available as to the effect of split application of fertilizers on the yield and other related characteristics. It is therefore, justified to say that more attention should be directed to the study of reasonable splitting rather than mechanical increase of fertilizers, if further increase of yield from paddy rice is to be expected. Emphasis should also be placed on the investigation of close spacings and its probable relationship with fertilization since it has been gradually becoming an important cultural practice in Taiwan.

The experiment reported here was designed to (a) determine the effects of two different methods of fertilizer application and two densities of planting on yield, components of yield and other characters, (b) determine the relationship between fertilization and density, and (c) determine the effect of fertilization and density on lodging of rice.

REVIEW OF THE LITERATURE

As early as 1939 in the wartime Japan, the effectiveness of fertilization at the ear primordia formation stage (panicle fertilization) was already recognized (Ishizuka and Tanaka, 1954). Noguchi (1949) investigated the effect of panicle fertilization

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from the physiological standpoint of rice and finally reached a conclusion that panicle fertilization was effective for the increase of panicle length, number of flowers per ear and the production of dry matter. Nagai (1959) also pointed out that split application of fertilizer during the period of ear primordia formation would greatly help the full development of panicles. Matsuo (1948) concluded that yield increase of rice by split fertilization at 20 to 30 days before heading was due primarily to (a) increase of ear-bearing tillers, (b) increase of the number of grains per ear and (c) favorable photosynthetic activities and ripening conditions which contributed to the increase of weight per 1,000 grains.

Split fertilization of fertilizer has been generally observed to be effective in nitrogen simply because it is more easily to loss either by leaching or by other means (Shirosita, 1954; Nagai, 1959). It may also be due to the fact that nitrogen is most closely related to the growth of rice than the other nutrients. Recently, however, the necessity of split application of potash fertilizer was also being stressed (Mitsui, 1954; Matsuwura, 1962). No significant difference was observed between the basal and split application of phosphate fertilizer (Matsuo, 1948).

The best time for applying split portions of nitrogen fertilizer was generally agreed to be: the first application at the time of maximum tillering stage or about 20 days after transplanting and the second application at the ear primordia formation stage or about 40 days after transplanting (Matsuwura, 1962). Yields were reduced when a split portion of nitrogen was applied later than 40 days after transplanting because of delayed maturity and increased danger of lodging (Mikkelsen and Miller, 1963). However, the nitrogen fertilization at the milk ripe stage or 80 days after transplanting was reported to be still effective for the increase of grain yield (Matsuwura, 1962).

The best splitting ratio for nitrogen fertilizer was suggested by Suzuki (1954) as 4:3:3 for basal, first top- and second top-dressings respectively, while Matsuwura (1962) obtained better results from both 2:2:6 and 2:4:4 for basal, first top- and second top-dressing respectively. The splitting ratio for potash fertilizer was, however, still unknown.

The relationship between split application and planting density was investigated by Noda (1946). He found that yield increase of split fertilization was greater in the closely spaced plots. Matsuwura (1962) observed that the length of internodes near the ground surface was considerably shortened by split fertilization which led to the reduction of lodging.

MATERIALS AND METHODS

The experiment was carried out on the second crop of 1963 at Chiayi Agricultural Experiment Station. The paddy field is of clay loam soil with pH value, organic matter and available phosphorus contents ranging from 5.3 to 5.6, 1.60 to 1.75% and 40 to 65 kg. per hectare, respectively, according to the analysis made by Taiwan Agricultural Research Institute.

The variety developed at this station, Chianung 242 was used in this experiment. It is of panicle type Japonica rice variety with large and heavy panicles. The culm of the plant is relatively tall, so it is generally susceptible to lodge. Nevertheless, it is highly resistant to rice blast disease (*Piricularia oryzae*) and is also noted for its high yielding ability.

Two treatments were included in this experiment: method of fertilization and planting density. In the method of fertilizer application, two methods were compared, i. e. conventional method of fertilizer application commonly practised by local farmers and the method of split application of fertilizers. All of P, K and half of N were used as a basal dressing and the balance of N used as a top-dressing at the time of second weeding or 20 days after transplanting in the former method while in the latter, all of P, 2/3 of K and 1/5 of N were applied as a basal dressing, 2/5 of N as first top-dressing made at the time of second weeding or 20 days after transplanting and the rest 1/3 of K and 2/5 of N used as second top-dressing at 42 days after transplanting. The total amount of fertilizers used in this experiment was 80, 40 and 40 kilograms per hectare for N, P and K respectively in both methods of fertilization.

For the planting density, there were two levels of planting density, i. e. conventional spacing with 64 hills per *Pen* (3.3 m^2) and high planting density with 96 hills per *Pen*. The distance between row was 24 cm for both densities while the distance within row was 21.5 cm and 14.3 cm for conventional and high planting densities respectively.

Each plot was 10 m^2 in area which is equal to 1/1,000 hectare. The experiment was laid out in split-plot design with methods of fertilizer application as the main treatments and the planting densities as sub-treatments. The experiment was replicted four times. It was transplanted on August 1, 1963 and was harvested on November 14, 1963.

Plant height and number of tillers per hill were recorded at 40 days after transplanting, while the number of panicles per hill and plant height were again measured at the full ripe stage. Heading date was recorded as the number of days from transplanting to about half of ear-bearing tillers being completely headed. The length of internodes, number of grains per ear, average weight of panicle, average length of panicles and weight of 1,000 grains were measured for each plot based on 20 randomly sampled plants, one from each hill. The percentage of lodging was recorded on the day before harvesting, and the grain yield was based on the total grain yield of each plot.

All data collected were subjected to the analysis of variance. In the percentage of lodging, arcsin transformation was made before conducting analysis, according to the method shown by Snedecor (1961).

EXPERIMENTAL RESULTS

Effects of Fertilizer Application and Planting Density on Yield and Components of Yield.

The average yield, components of yield and F values from the analysis of

variance are given in table 1.

Table 1. Grain yield, components of yield and their F values of rice variety Chianung 242 under different methods of fertilization and planting densities

Method of fertilization	Planting density (hills/Pen)	Grain yield (kg/ha)	Number of panicles per hill	Number of grains per ear	Weight of 1,000 grains (g)
Conventional	64	4,311.75	9.78	152.11	27.88
	96	4,515.75	7.88	144.98	28.06
Splitting	64	4,565.75	9.35	158.65	29.00
	96	4,866.75	7.23	146.51	29.31
Average for conventional	—	4,413.75	8.83	148.55	27.97
Average for splitting	—	4,711.75	8.29	152.58	29.16
F values	—	8.29	7.25	7.08	63.19**
LSD 1%	—	—	—	—	0.81
Average for 64 hills	—	4,434.25	9.57	155.38	28.44
Average for 96 hills	—	4,691.25	7.56	145.75	28.69
F values	—	12.16*	62.31**	2.35	0.29
LSD 5%	—	180.39	0.62	—	—
Fertilization X Planting density					
F values	—	0.52	0.19	0.16	0.01

* Difference significant at the 5% level.
** Difference significant at the 1% level.

Grain yield was 298 kg or 6.75% higher per hectare in split application of fertilizer than that of conventional one, a difference that just failed to reach a level of significance. High planting density of 96 hills per *Pen* (3.3 m^2) produced 257 kg or 5.79% more grain per hectare than that of 64 hills pre *Pen*, a planting density most commonly adopted by local farmers. This difference between planting densities exceeded the 5% level of significance.

Grains from split use of fertilizer were heavier than those from conventional one, averaging 1.19 gram or 4.25% heavier per 1,000 grains. This difference was significant at 1% level of probability. Grain weight was not affected by planting densities.

Methods of fertilization did not cause a significant change in the number or panicles per hill, even though it showed a slight increase in conventional fertilization. However, high planting density reduced nearly 2 panicles per hill, a difference greatly exceeding the 1% level of probability.

The number of grains per ear appeared to be unaffected by both treatments. Nevertheless, there was an indication for split fertilization to have slightly more grains per ear and for high planting density to produce less grains.

No significant interaction between fertilization and planting density was evident in grain yield and components of yield.

Effects of Fertilizer Application and Planting Density on some Agronomic Characters.

Agronomic characters measured in this study included heading date, plant height, number of tillers, panicle weight and panicle length. A summary of the data and F values conputed on these characters are presented in table 2.

Table 2. Means and F values of heading date, plant height, number of tillers, panicle weight and panicle length of rice variety Chianung 242 subjected to the treatments of fertilization and planting density

Method of fertilization	Planting density (hills/Pen)	Heading date (days)	Plant height		Number of tillers per hill	Panicle weight (g)	Panicle length (cm)
			40 days (cm)	Full ripe (cm)			
Conventional	64	60.5	88.8	109.2	9.0	4.3	23.06
	96	60.5	91.5	108.2	7.2	4.0	23.03
Splitting	64	59.0	85.8	111.9	8.4	4.6	24.73
	96	59.8	82.6	109.6	7.5	4.1	24.23
Average for cenventional	—	60.5	90.2	108.7	8.1	4.2	23.05
Average for conventional	—	59.4	84.2	110.8	8.0	4.4	24.48
F values	—	1.36	3.87	4.09	0.36	16.0*	274.72**
LSD 5%	—	—	—	—	—	0.16	0.28
Average for 64 hills	—	59.8	87.3	110.6	8.7	4.5	23.90
Average for 64 hills	—	60.2	87.1	108.9	7.3	4.1	23.63
F values	—	0.78	0.03	0.69	14.02**	4.33	0.84
LSD 1%	—	—	—	—	1.40	—	—
Fertilization X Planting F values	—	0.75	3.40	0.10	1.40	0.07	0.62

* Difference significant at the 5% level.

** Difference significant at the 1% level.

From table 2, heading date was found to be one day earlier in split fertilization than that of conventional one, but it remained almost the same in both planting densities. Planting height in split fertilization averaged 6 cm lower and 2 cm taller than that of conventional one at 40 days after transplanting and at full ripe stage respectively; while plant height of high planting density appeared to be consistently lower than that of low planting density at both stages. Differences in two characters, however, were not significant for both treatments.

The number of tillers was not affected by methods of fertilization, but it reduced 1.3 tiller per hill in high planting density, a difference greatly exceeding the 1% level of probability.

Panicles from split fertilization were significantly heavier than those from conventional one, but panicle weight was not significantly affected by planting densities. The length of panicles was 1.43 cm or 6.16% longer in split fertilization than that of conventional one. This difference was highly significant. Planting densities did not cause a significant change in panicle length.

In all characters analyzed, the interaction between fertilization and planting density appeared to be not significant.

Effects of Fertilizer Application and Planting Density on the Length of Internodes and Lodging.

The average length of internodes, the percentage of lodging and F values obtained from the analysis of variance for these two characters are summarized in table 3.

Table 3. Means and F values of the length of internodes and the percentage of lodging of rice variety Chianung 242 under different methods of fertilization and planting densities

Method of fertilization	Planting density (hills/Pen)	Length of internodes (cm)					Lodging (%)
		1st.	2nd.	3rd.	4th.	5th.	
Conventional	64	41.47	21.86	14.10	8.02	3.73	43.2
	96	42.46	22.35	12.77	8.05	2.49	46.3
Splitting	64	45.56	21.56	11.51	7.97	1.58	3.7
	96	45.58	21.51	10.84	7.49	2.11	15.7
Average for conventional	—	41.97	22.11	13.44	8.04	3.11	44.8
Average for splitting	—	45.57	21.63	11.18	7.73	1.85	8.7
F values	—	108.2**	2.12	17.24*	2.00	6.74	14.48*
LSD 5%	—	1.10	—	1.73	—	—	20.7
Average for 64 hills	—	43.52	21.80	12.81	8.00	2.66	19.4
Average for 96 hills	—	44.02	21.93	11.81	7.77	2.30	29.9
F values	—	0.33	0.20	9.96*	0.38	3.30	0.96
LSD 5%	—	—	—	0.77	—	—	—
Fertilization X Planting density F values	—	0.31	1.63	1.06	0.48	20.33**	0.53

* Difference significant at the 5% level.
** Difference significant at the 1% level.

The plant in split fertilization was found to have longer first internode but the rest of internodes were all shorter than those of conventional one. Differences in the first and third internodes exceeded the 1% and 5% levels of probability respectively; while those in the rest of internodes were not significant. Planting densities did not cause significant changes in all internodes except in the third internode where the difference between planting densities was significant at the 5% level of probability.

The percentage of lodging was lower in split fertilization than that of conventional one, the mean percentages of lodging being 8.7% and 44.8% respectively. This difference exceeded 5% level of significance. Planting densities did not significantly affect the percentage of lodging, even though there was a tendency for high planting density to have higher percentage of lodging.

The interaction between methods of fertilization and planting densities was not significant in the upper four internodes, but it was highly significant in the fifth internode. No significant interaction between the treatments was observed

in the percentage of lodging.

DISCUSSION AND CONCLUSIONS

It was observed in this experiment that split application of fertilizers produced higher grain yield than did conventional one, indicating that by merely adjusting the fertilizer usage could lead to the increase of yield. The results obtained were similar to those reported by other workers (Suzuki, 1958; Matsuwura, 1962). However, the difference in yield somehow failed to reach level of significance. This may be due largely to the allocation of fertilizer application to the main plots, thus reducing the efficiency of comparison in the main treatments.

The analysis of components of yield revealed that the number of panicles per hill and the number of grain per ear were not affected by methods of fertilization, but the weight of 1,000 grains was significantly increased by split application of fertilizers. It is probable, therefore, that yield increase caused by split fertilization may be attributable to the increase of grain weight.

The fact that fertilization at the ear primordia formation stage leads to the increase of the weight of grains and thus to the increase of yield, has been proved by many workers (Matsuo, 1948; Snzuki, 1958; Nagai, 1959). The fertilization at this stage seems to have twofold effects: one is to help make larger size of hulls and the other, to provide favorable conditions for the full development of the maturing grains. Nagai (1959) reported that the weight of mature grains is greatly influenced by the size of hulls which hold the ripening grains. The size of hulls can be modified to certain extent by the favorable growth condition during the ear primordia formation stage. If the container of the grain be made large, the development of the grain may proceed to the utmost size. Noguchi (1949) concluded that fertilization at ear primordia formation stage did increase the rate of CO_2 uptake and stimulate the activities of photosynthesis, thus contributed to the high dry matter content of the grain as well as producing a plump and heavy grain. It is well understood that the activities of photosynthesis are vital importance to the yield, since the grain yield depends on the products of photosynthesis stored in the grain in the form of starch.

The time of applying second top-dressing or so-called panicle fertilization seems to have played an important role on components of yield. Matsuo (1948) reported that fertilization at 20 to 30 days before heading resulted in the increase of ear-bearing tillers, number of grains per ear and weight of 1,000 grains. When fertilized at 10 to 15 days before heading, the latter two components would increase, but only the weight of 1,000 grains was increased if fertilized after 10 days before heading. His observation was found to be quite similar to the results obtained in this experiment. The second top-dressing was made at 42 days after transplanting or 16 days before heading in this experiment and it appeared to be a little late for the increase of panicles. This was reflected in the slight reduction of panicles in the treatment of split fertilization. The number of grains was slightly increased

but the effect of second top-dressing seemed to be centered on the increase of grain weight. The reduction of panicles did not affect the yield since it was reported that the relationship between the two was not necessarily parallel (Matsuwura, 1962). Matsuo (1948) and Suzuki (1958) also suggested that the number of panicles per hill and the number of grains per ear are merely the constructing components of yield which presumably contribute only to the potentiality of yield while the weight of 1,000 grains is the real decisive component of yield which determines the actual yield.

Grain yield was significantly increased by high planting density, indicating that close spacing was effective for the increase of yield. Since the components of yield were adversely affected by high planting density except the weight of 1,000 grains which remained unchanged, it would appear, therefore, that the yield increase in high planting density was contributed entirely by the increase of panicles per unit area. The total number of panicles per plot was calculated as 1,854 in conventional rate of planting while that of close spacing was 2,200, an increase of 346 panicles or 18.69%. This increase of panicles not only compensated for the reduction of the number of panicles per hill and the number of grains per ear but also contributed to the increase of yield. The same results were also reported by other workers. Mizukami (1962) observed the existence of a high correlation between the number of panicles per unit area and the grain yield in rice. Wilson and Swanson (1962) also found that a reduction in heads per square foot led to a significant reduction of grain yield in winter wheat.

It was indicated that a plot treated with split application of fertilizers and high planting density produced more yield, even though no significant interaction occurred between the treatments. The same result was also reported by Noda (1946). He concluded that the percentage of yield increase caused by split application of fertilizers was greater in the plots of high planting density. In view of a current trend prevailing in Taiwan to raise degree of planting density, the result obtained in this experiment seems to have a practical value, since it has pointed out a possibility of further yield increase by applying split fertilization in the closely spaced field.

Heading date was found to be one day earlier in split fertilization. Field observation made during the period of ripening stage clearly indicating that plants in the plots of split fertilization were far ahead in maturing. The early maturity of the plants in the plots of split fertilization may be caused by the application of potash fertilizer at second top-dressing. As observed by Mitsui (1954), potash fertilization at ear primordia formation stage was considered to be associated with the development of young panicles and to provide favorable conditions for the ripening of grains.

The effect of split application of fertilizer was probably best reflected in plant height. Under conventional method of fertilization, the growth of plants was generally vigorous at the early stage presumably due to sufficient amount of fertili-

zers available in the soil, but at the later stage, the growth was ocnsiderably depressed probably caused by the exhaustion of nutrients. This was clearly indicated by plant height, i. e. taller plants in the former and shorter ones in the latter. Furthermore, the prevailing climatic conditions in tropical area were reported to have a tendency to stimaulate the overgrowth of vegetative parts of rice (Suzuki, 1958). As a result, the occurrence of lodging as well as the prevalence of blast disease of rice may become more serious and this is actually the case in Taiwan. Split application of fertilizers seems to offer a probable solution to these problems. As revealed by the data, rice plants were well under control at the early stage of growth as indicated by shorter plant height in the plots of split fertilization, and they also maintained a better growth at the later stage.

The increase of panicle length in the plots of split application of fertilizer was found to be closely associated with panicle weight. A high correlation coefficient of +0.64 was obtained by Iso (1934) between these two characters. Noguchi (1949) also reported that the increase of panicle length was one of the significant responses of rice plants to the so-called panicle fertilization. It is believed that the increase of panicle length and panicle weight may be related to the increase of grain weight and thus, to grain yield.

A highly significant reduction in the number of tillers per hill presumably led to the highly significant reduction of the number of panicles per hill in the high planting density. It is suspected that the reduction of tillers as well as panicles per hill may be due largely to the keen competition for space and nutrients brought about by the increase of population density. Panicle weight and panicle length were also found to be reduced in high planting density. Wilson and Swanson (1962) also reported that heads generally decreased in weight and length as the population increased.

The length of the first internode in the plots of split fertilization averaged 3.6 cm longer than that of conventional one. Hosika (1961) reported that the length of the first internode was associated with the yielding ability of rice plant, the longer the first internode, the higher the yield. It seems reasonable to suppose that yield increase due to split application of fertilizers was made possible by the high yielding type of rice plant resulted from this fertilization.

Plants in the plots of split fertilization were generally found to have shorter internodes at lower part of the culm, and they also appeared to have low percentage of lodging, indicating that shorter basal internodes of rice plants may be related to lodging. This relationship was particularly conspicuous in the fifth internode. A similar observation was also made by other investigators. Hosika (1961) reported that longer fifth internode used to increase the danger of lodging. Matsuwura (1962) quoted Yamamoto as saying that lodging scarcely occurred when length of the fifth internode was shorter than 2.5 cm. Investigations made by Kaohsiung Agricultural Experiment Station (1963) revealed a tendency for a light unit weight of the third internode of rice plants to associate with a high percentage

of lodging. A significant difference in length of the third internode between methods of fertilization seemed to indicate that the length, in addition to unit weight, of the third internode was also related to lodging. However, the relationship between length and lodging was not clear in closely spaced plots, suggesting that other factors were also involved in the mechanism of lodging.

Lodging of two spacings responded similarly but in different degree to split fertilization. In wide spacing, the reduction of lodging due to split fertilization was larger than that of close spacing. Since the fifth internode was suggested to be related to lodging, a highly significant interaction occurred in this character seemed to indicate that a certain degree of interaction might also exist in lodging between the two treatments. Based on this observation, it appears promising that split fertilization may be an useful tool for an effective control of lodging.

In this experiment, splitting of fertilizer was made for N and K, but not for P. This was based on the fact frequently demonstrated by experiment and practical experience that yield response of phosphoric fertilizer is less significant in paddy soils. Nagai (1959) reported that nearly 70 percent of the phosphoric acid applied in paddy field could be retained in the soil as readily available ferrous phosphate and only 0.8 percent of it was lost through leaching, suggesting that splitting use of phosphoric fertilizer may be unnecessary. Mitsui (1954) also concluded that sufficient amount of phosphoric fertilizer applied as a basal dressing would be enough to cover the need for a maximum yield. Further investigations on this and other problems seem necessary.

SUMMARY

A panicle-type Japonica variety of rice Chianung 242 was subjected to two methods of fertilizer application namely, conventional and split methods, and two levels of planting density, 64 hills and 96 hills per *Pen* (3.3 m^2). The experiment was arranged in split plot design with methods of fertilization as main treatments and planting densities as sub-treatments. The experiment was replicated 4 times on the Experimental field of Chaiyi Agricultural Experiment Station in the second crop of 1963. Data on grain yield, components of yield and other agronomic characters were taken to determine the effect of both treatments as well as their interactions.

Split application of fertilizer was found to produce higher yield than conventional method of fertilization. The yield increase was found to be due largely to the increase of grain weight. The increase of grain yield by high planting density was also significant and it was attributable to the increase of panicles per unit area.

The weight and length of panicles were significantly increased by split application of fertilizers, but they were generally decreased as the plant population increased. Heading date and plant height were not significantly affected by both treatments.

The first internode was significantly longer in the plant of split fertilization but the rest of the internodes were shorter than those of conventional one. A similar trend of smaller magnitude was also observed in planting density. The long first internode of rice plant was found to be related to high grain yield.

Lodging was significantly reduced by split fertilization but no significant difference occurred in planting densities. The relationship between the length of internodes and the percentage of lodging was still not clearly understood.

A tendency for the plot of high planting density to produce higher yield under split application of fertilizer was revealed, although no significant interaction between the treatments was evident. A similar observation was also made in the percentage of lodging, indicating a possible reduction of lodging in the plots of high planting density by the use of split fertilization.

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水稻肥料分施與栽植密度對產量，產量構成因子及其他主要農藝性狀之效果

張萬來　楊遜謙

摘要

本試驗分肥料施用法與栽植密度兩處理。肥料施用法爲：肥料分施（基肥：N$\frac{1}{5}$，P 全量，K$\frac{2}{3}$，全層施肥，第一次追肥：N$\frac{2}{5}$ 於第二次除草時施用，第二次追肥或穗肥，N$\frac{2}{5}$，K$\frac{1}{3}$於插秧後42日施用）與慣行施肥法（基肥 N$\frac{1}{2}$，PK 全量，全層施肥，第一次追肥，N$\frac{1}{2}$於第二次除草時施用）兩種。栽植密度亦分兩級，即：密植或每坪96株與疏植或慣行栽植密度，每坪64株。本試驗於民國52年第2期作在嘉義農業試驗分所舉行，以明瞭各處理對水稻產量及主要農藝性狀之效果。茲將所得結果摘要如下：

肥料分施可增加每公頃乾淨谷產量百分之六・七五，經產量構成因子分析結果指出其增產原因爲谷千粒重之增加所致。增加栽植密度，增產百分之五・七九，差異顯著其產量之提高，乃得自單位面積內總穗數之增加。

每株分蘗及穗數不因肥料施用法而大幅增減，惟可隨栽植密度之增加而顯著減少。每穗粒數雖可因肥料分施而稍增，隨密植而稍減，但差異均不顯著，穗長與穗重因肥料之分施而顯著增加，惟因栽植密度之提高而減低，株高及生育日數，處理間差異均不顯著。

肥料分施增加稻莖第一節間長度，餘外節間頗顯縮短，而形成所謂多產型稻株。此結果經發現與產量之增加及倒伏之減少有關。惟倒伏性與稻莖節間長度之關係尙欠明瞭。

肥料施用法與栽植密度之間，雖未見顯著之交感作用存在，但肥料分施與密植之配合，每有增產之趨勢，而倒伏性亦有遞減現象。

REPORT ON EXPERIMENTS ABOUT THE SEEDS' SIZE OF KINMEN EARLY KOHLRABI

by

P. N. LEE

PREFACE

During 1957-58 Taiwan Agricultural Research Institute cultivated kohlrabies at Kinmen, Fukien. There was not a single drop of rain through all the seeding, setting, bolting and even harvesting stages. The weather was so dry that we had to solely depend on irrigation. Plants, therefore, was not brought up well. The size of seeds consequently became smaller. About 70% of grant total of seeds were small ones. We separated them by their size. Each thousand seed that weighed more than 3 gram was considered as the large size which consisted 10% of the sum total. The color of the seeds was brown-black, and the percentage of germination was about 97%. Those that weighed less than 3 gram but more than 1 gram was called the medium size. They were about 20%, brownish, and the percentage of germination was on an average of 64%. Those that weighed under 1 gram were small size. They were about 70%, reddish brown, and the percentage of germination was about 55%.

In order to study how the difference of size would effect their life and their future generation, we made a seed storage test and separate cultivation experiments. The result was as follows:

RELATION BETWEEN THE SIZE AND VITALITY OF THE SEEDS

We packed 200 gram of samplings of each size seeds and stored them into desicator. We tested their percentage of germination on June 1 just before storage, and then continually and regularly tested them on the beginning of every three months. They were kept for 18 months from June 1958 till December 1959. The result showed a great difference between the size and life of the seeds in storage. The degeneration of the percentage of germination of the large size seeds was only 21%, after 18 months in storage, and life still reserved in the rest 76% seeds; the medium size ones degenerated to 37%, only 27% had life in them; and the small size seeds' percentage of germination was cut to 12% after 12 months in storage, the degeneration was 43%, all the seeds lost their life after 15 months. It is evident then that the small size seeds can not be stored long, and life is very short. The medium size and small size seeds do not have sound organism, their living structure will no longer exist after long-period storage.

Table 1 Percentage of Germination of Seeds in Storage

Size of seeds	Wt. of 1,000 seeds	% of germination at harvest time	% of germination of seeds in storage					
			1958		1959			
			Sept.	Dec.	March	June	Sept.	Dec.
Large seeds	3.29 g.	97	94	91	88	87	78	76
Medium seeds	1.38	64	65	60	56	46	38	27
small seeds	0.76	55	48	37	25	12	0	0

Explanation: (1) The percentage of germination of seed picking time is based on the seeds picked on May 10, and tested on June 1.
(2) Each germination experiment was the result of the average after 5 times repetition.

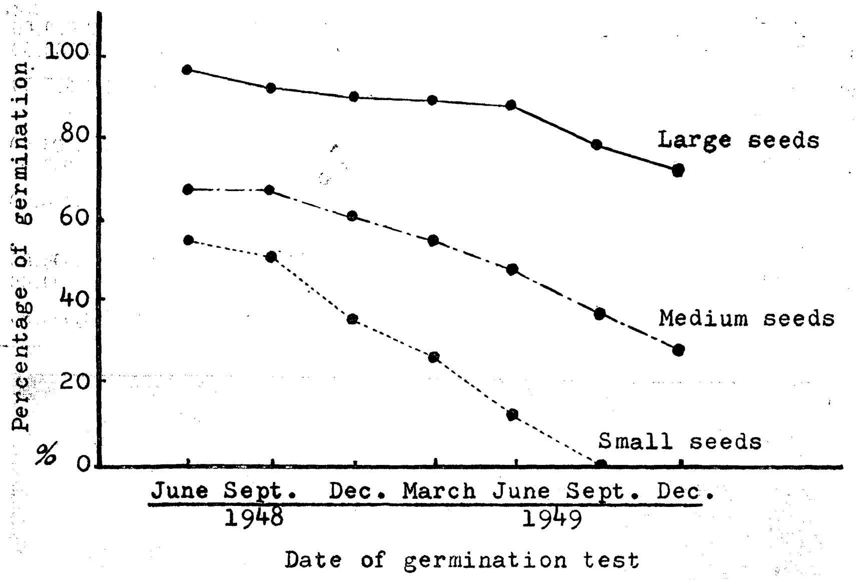


Fig. 1 Relation between the size and vitality of seeds during the storage period

RELATION BETWEEN THE SIZE AND VITALITY OF THE FUTURE GENERATIONS

Based on the aboved said experiment, the difference between the size and life of the seeds are quite important. In order to examine the physical genetics of the future generation, we sowed seeds of difference size on September 16, 1958 and cultivated them under same environment and condition. The result: in seeding stage the cotyledon of medium and small size seeds were small, light green in color, and not very strong and healthy; while that of the large size seeds were big and strong, green color. 20 days after germination the difference among all size seeds were not worth telling. Setting on October 14, and harvest came on December 24 and January 10. They grew in the field from setting to harvest for 69 days and 86 days respectively. During that period in the field, nothing noticeable about the difference of the color and shape of the leave, or the condition of their buld, based on their

original size of seeds. As a matter of fact, the yield of large size seeds were, whether in early or later harvest, not productive as that of the medium and small size seeds. The average yield of every 10 acre of large size seeds were 2,605.0 kg. Whereas that of the medium and small size seeds were 3,414.0 kg. and 2,998.5 kg. respectively. Therefore, we can be sure that the size of seeds has nothing to do with their yield or with their future generation, but the size of seeds has great influence on seed picking. Also we must consider the demerit or percentage of germination of the medium and small size seeds.

Table 2 Yield Based on the Size of Seeds of Kinmen Early Kohlrabi

Size of seed	Wt. of 1,000 seeds	% of ger-mination	Date of sowing	Date of planting	Date of harvest	Days of growth	No. of plant per 0.1 a.	Yield per 10 a.	wt. per plant
	g.							kg.	g.
Large seeds	3.29	97	Sept. 16	Oct. 14	Dec. 24 Jan. 10	69 86	50 50	2,029.00 3,182.00	405.40 636.40
Average	—	—	—	—	—	—	—	2,605.50	521.10
Medium seeds	1.38	64	Sept. 16	Oct. 14	Dec. 24 Jan. 10	69 86	50 50	2,893.00 3,930.00	579.50 785.95
Average	—	—	—	—	—	—	—	3,414.00	632.70
Small seeds	0.76	55	Sept. 16	Oct. 14	Dec. 24 Jan. 10	69 86	50 50	2,998.00 2,999.00	599.60 599.80
Average	—	—	—	—	—	—	—	2,998.50	599.70

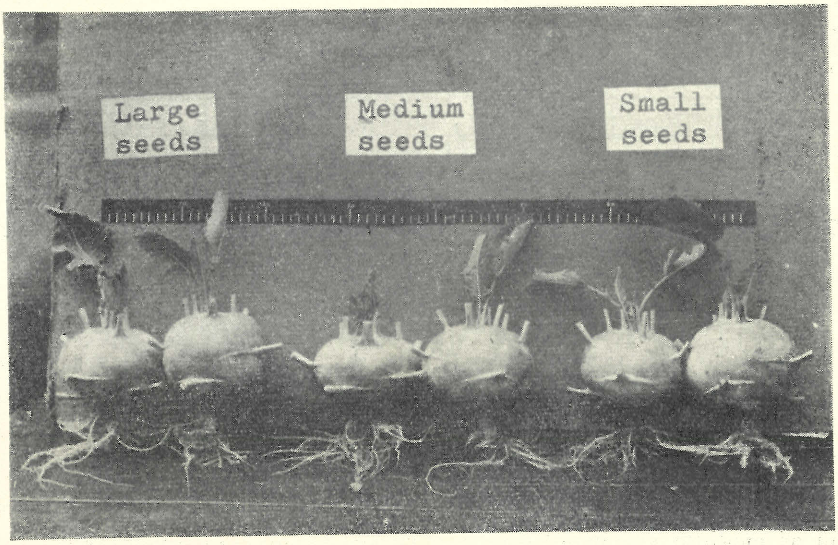


Fig. 2 Comparison between the size of seeds and the form of bulb of Kinmen Early Kohlrabi

CONCLUSION

1. Influenced by the factors such as the environment of seed-picking place, time of planting, fertilizing, management and the different part of picking, picked the

seeds of same variety may inevitably have different size.

2. Kinmen Early kohlrabi cultivated at Kinmen did not grow well because of dry weather. The size of seeds had obvious difference.

3. The large size seeds have strong organism and promising development, they can be kept longer and still reserve life, medium and small size seeds have weak organism, they can lose their life very shortly in storage.

4. The size of seeds does not affect the yield. The medium and small size seeds can product more than the large size ones. But the germination of the former is not good, and their life can not last long in storage.

金門早生球莖甘藍種子大小試驗報告

李 伯 年

中 文 摘 要

1. 同品種蔬菜種子，受採種地環境、栽植期早晚、施肥、管理以及採種部位之不同等諸因子之影響，所採種子難免有大小不齊之實際情形。

2. 在金門採種之早生球莖甘藍，受天氣長期乾旱，發育未能十分充分，致種子形粒大小差別甚大。

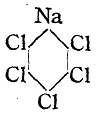
3. 大粒種子發育充實，生活機能亦强，故在貯藏中不易失去生命。中小粒種子，因生活機能不强，在貯藏中易於消失生命。

4. 在產量方面，不因種子形粒變小而有差別。反而中、小粒種子之產量較大粒種子爲多。中、小粒種子發芽不佳，且在貯藏中易於消失生命，實爲美中不足之處。

PCP鈣氰氮化鈣對水稻之肥效及除草效果試驗(第一報)

林國謙　溫西濱　王清演

一、前　　言

「PCP」鈉爲英名 Sodium-penta chlorophenolate 之簡稱，國名稱爲「五氯酚鈉」，分子式 $C_6Cl_5 \cdot Na$，分子量 288，分子構造 

，具有强烈刺激性，可溶於水及酸性溶液，PCP 從前其主要用途爲木材防腐劑，白蟻防除，纖維防黴，旱田殺草用，冬季果樹休眠期間充爲殺菌劑與石灰硫黃劑混合使用等。最近在日本始對於稻田以殺草劑使用，其效果相當顯著，如一般除草劑效果不佳之稗子，藻草類及非宿根性的一般廣葉雜草類等，PCP 之施用對此種雜草類卽具有卓著之殺草效果，因此日本農業界對此問題相當注目與期待，PCP 不但具有殺草效果，依殺菌力强烈之觀點而可推察，施用於土壤後可能抑制氮質肥料在土壤中氮素之硝化作用，但 PCP 施用過量時對作物具有藥害作用，是故其使用量在日本經試驗結果認爲每公頃10公斤左右較爲適宜，若直接撒佈於水田時（一般農家皆用 PCP 1公斤：土壤20公斤或 PCP 1公斤：水 80-100公升之比率混合或溶解後使用），作業上不但具有種種困難，如操作煩雜，有毒性，刺激性强等，尙且水稻多少受其接觸之害作用等種種弊害。

氰氮化鈣在本省消費額達相當鉅量，經製成 PCP 鈣氰氮化鈣大量供應時，對糧食增產貢獻至鉅，而本省有關 PCP 殺草效果試驗資料可謂殆無，且在肥料學的立場而言，實屬目前亟待辦理之試驗研究。

本試驗之目的爲探討 PCP 鈣氰氮化鈣對水稻產量，及除草效果爲目的，供試材料係臺灣碱業公司製成之 PCP 鈣氰氮化鈣，在屛東及桃園設置試驗田擧行田間栽培試驗，現將民國五十一年試驗成績加以整理檢討並將結果報告於後，尙請農界不吝指正。

本試驗經費承臺灣碱業公司及部份承蒙國家長期發展科學委員會補助，並由屛東林漏義，桃園李阿上兩位先生熱誠協助田間試驗得以完成，謹誌於此表示謝忱。

二、試驗方法

本試驗在屛東，桃園兩地擧行，設七處理（如表一），田間設計採用隨機排列，四重覆共有28小區，每小區面積爲20平方公尺（$4m \times 5m = 20m^2$）每小區插秧 320 株，田間管理方法均按慣行法行之。

表一　處理項目與三要素施用量

代號	處理名稱	三要素量 (kg/ha)			肥料施用量（克/每小區）						施肥方法
		N	P_2O_5	k_2O	PCP鈣氰氮化鈣	氰氮化鈣	硫酸錏	過石	硫酸鉀	五氯酚鈉	
1	無氮區	0	40	40	0	0	0	444	168	—	基肥
2	氰氮化鈣區	80	40	40	0	800	0	444	168	—	全層施肥

3	PCP鈣氰氮化鈣區	80	40	40	842	0	0	444	168	—	全層施肥
4	氰氮化鈣+五氯酚鈉區	80	40	40	0	800	0	444	168	40	〃
5	氰氮化鈣+硫酸銨區	80	40	40	0	400	400	444	163	—	氰氮化鈣爲基肥硫酸銨爲追肥
6	PCP鈣氰氧化鈣+硫酸銨區	80	40	40	421	0	400	444	168	—	PCP鈣氰氮化鈣爲基肥硫酸銨爲追肥
7	硫酸銨區	80	40	40	0	0	800	444	168	—	半量基肥、半量追肥

三、試驗結果

1. 谷藁收量調查：本試驗每於收穫後將各處理區谷、藁乾燥後，分別秤其乾態重量。茲將兩試驗地民國五十一年度第一、二期作谷藁收量及其百分率指數分別列示如下：

表二 桃園試驗地第一期作 (單位：公斤/公頃)

處理名稱＼重覆別	谷藁	I	II	III	IV	平均	指數(%)
無氮區	谷	3,420	3,030	3,100	3,550	3,280	100.0
	藁	3,290	3,220	4,550	4,050	3,820	100.0
氰氮化鈣區	谷	4,600	4,690	4,340	4,600	4,570	139.5
	藁	5.600	9,100	4,900	4,800	6,100	159.9
PCP鈣氰氮化鈣區	谷	4,190	4,490	4,380	4,710	4.444	135.6
	藁	5,600	5,400	5,400	4,970	5,300	138.9
氰氮化鈣+五氯酚鈉區	谷	4,780	4,820	4,820	4,600	4,760	145.2
	藁	5,050	5,590	5,250	5,850	5,530	144.7
氰氮化鈣+硫酸銨區	谷	4,820	4,250	3,770	3,760	4,150	126.7
	藁	5,600	5,250	5,100	4,900	5,220	136.7
PCP鈣氰氮化鈣+硫酸銨區	谷	4,190	4,420	4,670	4,600	4,470	136.5
	藁	5,800	4,600	5,250	5,750	5,350	140.2
硫酸銨區	谷	4,350	3,920	4,200	4,950	4,490	137.1
	藁	5,750	7,650	5,350	5,300	6,270	164.2

桃園試驗地第二期作 (單位：公斤/公頃)

處理名稱＼重覆別	谷藁	I	II	III	IV	平均	指數(%)
無氮區	谷	3,182	2,467	2,793	3,092	2,884	100.0
	藁	3,850	4,235	3,118	3,465	3;667	100.0
氰氮化鈣區	谷	3,919	4,360	3,753	3,615	3,912	135.6
	藁	4,235	5,005	5,390	4,108	4,685	127.8
PCP鈣氰氮化鈣區	谷	3,897	4,029	4,024	3,897	3,962	137.4
	藁	5,775	5,005	4,235	4,851	4,967	135.5
氰氮化鈣+五氯酚鈉區	谷	4,085	3,919	3,897	4,360	4,065	140.9
	藁	5,005	4,548	3,620	3,620	4,198	114.5
氰氮化鈣+硫酸銨區	谷	3,476	3,621	3,588	3,345	3,508	121.6
	藁	4,235	5,005	4,851	3,750	4,460	121.6
PCP鈣氰氮化鈣+硫酸銨區	谷	3,345	3,696	3,643	3,350	3,509	121.6
	藁	4,620	3,657	5,775	4,158	4,552	124.1

處理名稱	谷藁	I	II	III	IV	平均	指數(%)
硫酸錏區	谷	3,312	3,538	2,925	3,477	3,313	114.9
	藁	3,850	4,620	4,466	2,887	3,956	107.9

屏東試驗地第一作收量表 (單位：公斤/公頃)

重覆別 / 處理名稱	谷藁	I	II	III	IV	平均	指數(%)
無氮區	谷	4,250	4,200	4,650	4,100	4,300	100.0
	藁	2,950	3,350	3,550	3,850	3,425	100.0
氰氮化鈣區	谷	5,600	5,000	5,850	5,700	5,875	136.6
	藁	3,100	3,350	3,550	3,850	3.463	101.1
PCP鈣氰氮化鈣區	谷	5,200	6,150	6,250	6,250	5,975	138.7
	藁	3,250	3,900	3,900	3,900	3,738	109.1
氰氮化鈣＋五氯酚鈉區	谷	6,500	6,250	6,350	5,500	6,150	143.0
	藁	3,000	3,650	4,000	3,350	3,500	102.2
氰氮化鈣＋硫酸錏區	谷	6,250	6,400	6,200	6,100	6,238	145.1
	藁	3,750	3,900	4,150	4,200	4,000	116.8
PCP鈣氰氮化鈣＋硫酸錏區	谷	6,100	5,850	6,400	6,500	6,213	144.5
	藁	4,200	3,150	4,050	3,900	3,825	111.7
硫酸錏區	谷	6,600	6,250	5,750	6,750	6,338	147.4
	藁	3,650	4,000	4,150	4,100	3,975	116.1

屏東試驗地第二期作收量表 (單位：公斤/公頃)

重覆別 / 處理名稱	谷藁	I	II	III	IV	平均	指數(%)
無氮區	谷	1,900	1,850	1,950	1,700	1,850	100.0
	藁	2,000	1,850	2,000	1,950	1,970	100.0
氰氮化鈣區	谷	1,875	2,200	2,125	1,925	2,031	109.8
	藁	2,200	2,350	2,350	2,000	2,225	112.9
PCP鈣氰氮化鈣區	谷	2,350	2,200	2,150	2,350	2,263	122.3
	藁	2,200	2,250	2,000	2,400	2,213	112.3
氰氮化鈣＋五氯酚鈉區	谷	2,150	1,900	2,575	1,925	2,138	115.6
	藁	2,250	2,200	2,200	2,300	2,238	113.6
氰氮化辦＋硫酸錏區	谷	2,000	2,250	2,225	1,850	2,081	112.5
	藁	2,500	2,450	2,400	2,550	2,475	125.6
PCP鈣氰氮化鈣＋硫酸錏區	谷	2,000	2,150	1,900	2,200	2,063	111.5
	藁	2,500	2,550	2,300	2,600	2,488	126.3
硫酸錏區	谷	1,975	1,975	1,700	1,750	1,850	100.0
	藁	2,450	2,450	2,050	2,650	2,400	121.8

2. 雜草量調查：本試驗每期作舉行雜草量調查二次，玆將桃園試驗地乾態雜草調查量列於表三。

表三　桃園試驗地雜草調查表　　(重量單位：克/小區)

處理名稱＼雜草量＼期作別	五十一年第一期作				五十一年第二期作			
	第一次除草	指數	第二次除草	指數	第一次除草	指數	第二次除草	指數
無氮區	43	100.0	756	100.0	69	100.0	1,850	100.0
氰氮化鈣區	24	55.8	626	82.8	70	101.5	1,620	87.7
PCP 鈣氰氮化鈣區	26	60.5	292	38.6	49	71.1	1,210	65.5
氰氮化鈣+五氯酚鈉區	11	25.6	151	20.0	47	68.2	800	43.3
氰氮化鈣+硫酸銨區	37	86.0	1,501	198.5	65	94.2	2,050	110.7
PCP 鈣氰氮化鈣+硫酸銨區	35	81.4	929	122.9	70	101.5	2,000	10.81
硫酸銨區	46	107.0	1,271	168.1	74	107.2	1,920	103.1

四、試驗結果檢討

民國五十一年第一、二期作，桃園、屏東兩試驗地谷藁產量列於表二，並以無氮區產量指數為100，分別計算其他各處理區之產量指數。就第一期作谷產量而言，桃園試驗地即氰氮化鈣＋五氯酚鈉區收量最優，氰氮化鈣區次之，硫酸銨區又次之，PCP 鈣氰氮化鈣區與PCP 鈣氰氮化鈣＋硫酸銨區兩處理間之收量相差無幾，與無氮區比較概有 26-45%之增收。屏東試驗地即硫酸銨區收量最優，氰氮化鈣＋硫酸銨區次之，PCP 鈣氰氮化鈣＋硫酸銨區又次之，PCP 鈣氰氮化鈣＋五氯酚鈉區最次之， PCP 鈣氰氮化鈣區略優於氰氮化鈣區之收量，施氮各區與無氮區比較概有 36-47%之增收。就第二期作谷產量而言，桃園試驗地之收量，以氰氮化鈣＋五氯酚鈉區最優，PCP 鈣氰氮化鈣區次之，氰氮化鈣區又次之，硫酸銨區最差，概有 14-40%之增收。屏東試驗地即 PCP 鈣氰氮化鈣區收量最優，氰氮化鈣＋五氯酚鈉區次之，氰氮化鈣＋硫酸銨區又次之，硫酸銨區最差，概有9-22%之增收。

由試驗結果觀之，PCP 鈣氰氮化鈣在第一期作，若充為基肥施用時，其肥效雖接近硫酸銨區之收量（尤以桃園試驗地），但半量氮素以 PCP 鈣氰氮化鈣充為基肥，餘半量氮素以硫酸銨充為追肥施用時，其肥效與硫酸銨施用區之收量相差無幾。在第二期作 PCP 鈣氰氮化鈣之肥效遠優於硫酸銨施用區，換言之，PCP 鈣氰氮化鈣對水稻之增產效果，在第二期作較優於第一期作。

至於對除草效果而言，（屏東試驗地用觀查方法調查雜草量），氰氮化鈣十五氯酚鈉區效果最優，可謂殆無雜草發生，PCP 鈣氰氮鈣區次之，氰氮化鈣區又次之，硫酸銨區最差。

就生育狀況而言，氰氮化鈣＋五氯酚鈉區及 PCP 鈣氰氮化鈣區兩處理，在生育初期雖略遭受 PCP 之藥害生育被抑制（尤以株高），但後漸次恢復，至生育後期即遠勝超出其他各處理區。

五、結論及提要

本試驗於民國五十一年在桃園、屏東兩地舉行田間試驗，其結果提要如下：由試驗結果觀之，PCP 鈣氰氮化鈣在第一期作，若充為基肥施用時，其肥效雖接近硫酸銨區之收量，但半量氮素以 PCP 鈣氰氮化鈣充為基肥，餘半量氮素以硫酸銨充為追肥施用時，其肥效與硫酸銨施用區之收量相差無幾。在第二期作 PCP 鈣氰氮化鈣之肥效遠優於硫酸銨施用區，換言之，PCP 鈣氰氮化鈣對水稻之增產效果，在第二期作較優於第一期作。

至於對除草效果而言，氰氮化鈣＋五鈣酚鈉區，效果最優， PCP 鈣氰氮化鈣區次之，氰氮化鈣區又次之，硫酸銨區最差。

就生育狀況而言，氰氮化鈣＋五鈣酚鈉區及 PCP 鈣氰氮化鈣區兩處理生育初期雖受 PCP 之藥害而生育被抑制，但以後漸次恢復，至生育後期其生育狀況即遠超出其他各處理區。

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EXPERIMENT ON THE AVAILABILITY OF PCP-CALCIUM CYANAMIDE FOR PADDY RICE AND ITS EFFECT ON WEEDING

by

K. C. LIN, H. P. WEN & C. Y. WANG

SUMMARY

The experiment was conducted in Taoyuane and Pintung for two crops in 1962. The result indicated that the availability of PCP-Calcium Cyanamide was corresponding to that of ammonium sulfate in the first crop and was even superior than the latter in the second crop.

Besides its availability as a nitrogenous fertilizer, its effect on weeding was also significant. Though the early growth of paddy was a little effected by the toxicity of PCP ingredient in the fertilizer, however it was soon recovered, and the growth became even better than that of the Check (ammonium sulfate plot) later.

種子殺菌劑處理對菜豆白絹病防除之效果

吳 福 壽

一、緒 言

年來本省為適應當前人口激增之需要，蔬菜栽培面積雖已逐漸增加，惟其產量尚不足實際需要。為謀今後蔬菜之供應充足，鼓勵增產及病害防除工作，應兼籌並進。

據年來田間觀察，菜豆 (*Phaseolus vulgaris* L.) 常受白絹病、菌核病、炭疽病等為害，招致種子無從發芽或發芽之後凋萎枯死，損失甚鉅，每期作因白絹病菌 (*Sclerotium rolfsii* Sacc.) 之侵害而枯死之植株約為15～20%，此病多發生在6月至9月之間。

過去本省蔬菜園藝界，對於氣中傳染之病害通常施行藥液撒佈，由種子傳染者多以藥液浸種消毒，效果良佳。惟白絹病菌之傳播情形較為複雜，該病原菌可潛伏於田間之病株上或土壤中越冬，當種子播下之後，侵害種子使其無從發芽，或當發芽時侵害幼根、幼芽使其腐爛，又發芽之後侵害幼植物之接地部份，招致凋萎枯死，減低立芽率 (Percentage stand)，故誠非藥液撒佈或藥液浸種所能根絕其害。在本省，至目前為止，尚乏有效對策。

據鈴木[7]氏 (1959) 瀧元[9]氏 (1959) 等報告，豆科植物之種子，以拌種處理效果較優。Gerdemann[2]氏 (1951) 謂處理之苜蓿及紫雲英種子，在乾燥或潮濕之土中，仍不影響其藥效。

本試驗目的在探究適用於防除菜豆白絹病之藥劑及用量，與種子發芽及生長之影響。玆將所得結果列述如下，以資參考。

本試驗承蒙所長徐水泉博士指導，文成後復蒙校閱，並承臺大教授陳其昌先生校正，當試驗進行時，承本系簡錦忠先生惠供殺菌劑，特此謹致謝忱。

二、試驗材料及方法

1. 試驗材料：

A 供試之菜豆白絹病病原菌，係由本所矮性長鶉菜豆之病株上所分離培養者。

B 供試菜種為矮性長鶉菜豆種子。

C 供試殺菌劑計10種，每種各分為 0.2%、0.3%、0.5%之三種不同用量。玆將供試藥劑之製造公司及其有效成分列於表一：

表一 供試殺菌劑及其有效成分

Table 1. Kinds of fungicides tested and their ingredients.

藥劑種類 Fungicides	製造公司 Manufacturer	有效成分 Active ingredients
Copper Sandoz	瑞西 Sandoz Ltd.	50% Cuprous oxide
Ceresan	日本特殊農藥公司	3.6% Phenyl mercuric acetate (Hg 1.5%)
Riogen dust	中農化工廠	0.25% Phenyl mercuric acetate (Hg 0.15%)
Granosan	美國 E. I. Du Pont de Nemours & Co.	5% Ethyl mercury phosphate
Semesn	美國 E. I. Du Pont de Nemours & Co.	30% Hydroxymercuri-Chlorophenol
Arasan	美國 E. I. Du Pont de Nemours & Co.	50% Thiram (Tetramethyl-thiuram disulfide)
Asozin dust-15	日本庵原農藥公司	0.15 Methylarsin sulfide
Blaes dust-2	日本農藥公司	0.2% Blasticidin S

Blaes M dust	日本農藥公司	0.1% Blasticidin 0.166% PMA (Phenyl mercuric acetate)
Spergon	美國 E. I. Du Pont de Nemours & Co.	96% Tetrachloropara-benzoquinone

2. 試驗方法：

本試驗分室內及盆栽兩部份，分別進行。種子處理法，均按粉衣法行之，每種藥劑各分爲三種不同用量，共30處理，另設無處理者一，以資對照。藥劑用量係以乾種子重量計算。每一種處理用種子 100g. ，置之於 400cc. 之三角瓶中，，倒入一定量之藥劑，然後緊塞瓶口，徐徐平搖，上下搖動約三分鐘，務使藥劑塗佈均勻。

在室內，將病原菌培養於馬鈴薯培養基（馬鈴薯 200g. 、蔗糖 20g. 、洋菜 20g. 及蒸溜水 1,000cc.），置放30°C之定溫箱內，經6～7日後供用，另備馬鈴薯培養基，溶解後倒入培養皿（直徑 9cm.），待其凝固後，取上述病原菌菌核1顆移植至其上面中心部位，當病原菌菌絲向四周伸長至略呈圓形時（徑約0.5～0.7cm.），用鑷子隨意取出已處理之種子 2 顆，置之於上述菌絲生長圈邊緣，將此培養皿置放 30°C 之定溫箱內，經一定日數，觀察附於種子上殺菌劑抑制病原菌菌絲生長之情形，測定菌絲生長圈直徑（平均）及被抑制部份之直徑（平均），以求其抑制比，俾類推粉衣處理，對自然環境下病原菌所伸長菌絲之接近，保護種子之效果。

盆栽試驗時，用長方形鉛鐵盤（體積爲44×29×7cm.），內盛定量砂土，將處理後之種子排置於盤中，每處理播種子 100 顆（每盤三種處理），距離一定，蓋上薄土，逐日觀察，並調查發芽數目。最後測定芽長、根長、根數等，以比較其結果。試驗在溫室內進行，試驗期中室內晚間溫度爲 24°～28°C, 日間溫度爲 30°～43°C。

三、試 驗 結 果

1. 藥劑處理對菜豆白絹病病原菌之制菌效果。

本試驗每處理三重複，經一定日數測定其抑制狀況，其結果如表二及圖1：

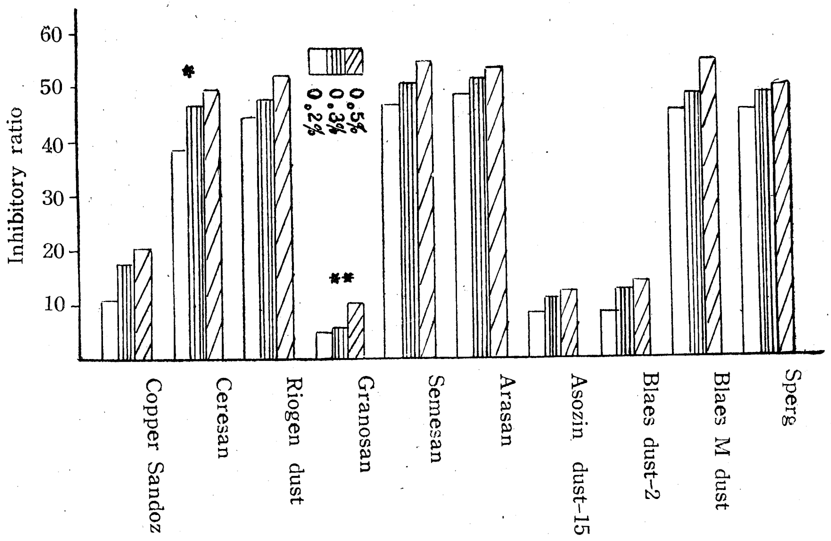
表二 藥劑處理對菜豆白絹病病原菌發育之抑制效果

Table 2. Effectiveness of certain fungicides against the development of *Sclerotium rolfsii* Sacc.

藥劑種類 Fungicides	藥劑用量 Dose (%)	菌絲生長之抑制效果 $(\frac{a-b}{a})$ Inhibitory effect on mycelial growth	備考*** Remarks
Copper Sandoz	0.2	10.09	菌絲密，形成頗多褐色小菌核
	0.3	17.64	菌絲密，形成多量褐色小菌核
	0.5	20.56	菌絲疎，形成多量褐色中形菌核
Ceresan	0.2	38.75 *	沿處理種子之菌絲部份特別長密，呈異狀發育
	0.3	46.50 *	沿處理種子之菌絲部份特別長密，呈異狀發育
	0.5	49.54 *	沿處理種子之菌絲部份特別長密，呈異狀發育
Riogen dust	0.2	44.47	形成淺黃色少量稍大菌核
	0.3	47.81	形成白色少量稍大菌絲塊
	0.5	52.15	只有菌絲長至處理種子之周圍
Granosan	0.2	4.97 **	菌絲殆全停止伸長，氣中菌絲倒伏萎縮
	0.3	5.64 **	菌絲殆全停止伸長，氣中菌絲倒伏萎縮
	0.5	10.17 **	菌絲殆全停止伸長，氣中菌絲倒伏萎縮

Semesan	0.2	46.79	形成少量黃褐色菌核
	0.3	50.75	形成少量白色菌絲塊及極少量淺黃色菌核
	0.5	54.35	形成少量白色菌絲塊及極少量淺黃色菌核
Arasan	0.2	48.69	菌絲密，形成多量黃褐色大菌核
	0.3	51.01	菌絲密，形成中量淺黃褐色大菌核
	0.5	53.41	菌絲疎，形成淺黃褐色中量大菌核
Asozin dust-15	0.2	8.53	菌絲密，形成頗多黃褐色中形菌核
	0.3	11.16	菌絲密，形成頗多黃褐色中形菌核
	0.5	12.43	菌絲密，形成頗多黃褐色中形菌核
Blaes dust-2	0.2	8.81	菌絲甚密，形成多量淺黃褐色大形菌核
	0.3	12.69	菌絲甚密，形成多量淺黃褐色大形菌核
	0.5	14.34	菌絲密，形成多量淺黃褐色中形菌核
Blaes M dust	0.2	45.64	菌絲密，形成多量淺褐色大菌核
	0.3	48.04	菌絲疎，形成白色中量大菌絲塊
	0.5	54.75	菌絲疎，形成白色少量大菌絲塊
Spergon	0.2	45.64	菌絲密，形成多量黃褐色大菌核
	0.3	48.74	菌絲疎，形成中量黃褐色大菌核
	0.5	50.38	菌絲疏，形成中量黃褐色大菌核
CK		0.00	菌絲甚密，形成頗多黃褐色中形菌核

註：a菌絲生長圈直徑（平均）。b被抑制部份之直徑（平均）。
* 沿處理種子之菌絲部份特別長密，呈異狀發育。 ** 自置放處理種子之後，菌絲殆全停止伸長，氣中菌絲倒伏萎縮，似有被所發生瓦斯毒死之現象。 *** 處理培養後經10日取出觀察之病原菌發育情形。



圖一、各種藥劑對病原菌菌絲生長之抑制比大小比較

Fig 1. Comparison of effectiveness of certain fungicides against the development of *Sclerotium rolfsii* Sacc.

註：* 沿處理種子之菌絲部份特別長密，呈異狀發育，抑制力強。
**自置放處理種子之後，菌絲殆全停止伸長，氣中菌絲倒伏萎縮，似有被所發生瓦斯毒死之現象，雖無法顯明現示抑制比，惟抑制力頗強。

由上表及圖可知：對 *Sclerotium rolfsii* 菌絲生長之抑制效果最優者爲 Granosan, Ceresan, ，其次 Arasan, Semesan, Blaes M dust 等之抑制情形亦佳， Spergon, Riogen dust 等之

抑制效果亦良好，0.5%之用量時，其抑制部份較菌絲生長圈直徑，可超出一半以上。Copper Sandoz, Blaes dust-2, Asozin dust-15 等之抑制力較劣。

2. 藥劑處理對種子發芽及生長之影響

本試驗在溫室內，將處理後之種子播下後，逐日觀察發芽情形，經十日之後調查生長情形，其結果如表三：

表三 藥劑處理對種子發芽及生長之影響

Table 3. Effect of seed treatment on seedling emergence and seedling stand.

處理 Treatment applied: 藥劑種類 Fungicides	處理 Treatment applied: 藥劑用量 Dose (%)	發芽 Seedlings emerged: 百分率 Percentage (%)	發芽 Seedlings emerged: 指數 Index	芽長 Length of bud: 平均 Average (cm.)	芽長 Length of bud: 指數 Index	根長 Length of root: 平均 Average (cm.)	根長 Length of root: 指數 Index	根數 No. of root: 平均 Average (支)	根數 No. of root: 指數 Index	備考* Remarks
Copper Sandoz	0.2	84	124	15.59	116	11.07	115	10.8	74	甚整齊
	0.3	73	107	17.66	132	11.57	120	13.2	91	
	0.5	79	116	19.19	142	11.14	116	12.2	84	
Ceresan	0.2	83	122	18.61	139	15.36	160	13.6	94	有凋萎者
	0.3	83	122	20.44	152	14.04	146	13.5	93	
	0.5	84	124	16.06	112	12.67	132	9.9	68	
Riogen dust	0.2	82	121	23.32	174	9.70	101	14.8	102	有甚多凋萎者
	0.3	85	125	19.92	148	11.83	123	8.2	57	
	0.5	75	110	13.85	103	11.60	121	9.8	68	
Granosan	0.2	70	103	21.44	160	11.02	115	9.2	63	與CK略同
	0.3	50	74	18.67	139	14.55	151	6.5	45	莖粗肥頗缺齊
	0.5	63	93	20.38	152	12.83	134	7.9	54	
Semesan	0.2	86	126	19.44	145	12.19	130	13.3	92	頗整齊
	0.3	86	126	18.63	139	11.91	124	13.0	90	
	0.5	82	121	18.83	140	11.45	119	13.6	94	
Arasan	0.2	86	126	18.37	139	11.59	121	11.8	81	甚整齊
	0.3	81	119	21.47	160	12.54	131	11.7	81	
	0.5	76	112	19.62	146	11.91	124	12.5	86	
Asozin dust-15	0.2	81	119	21.08	157	12.30	128	12.5	86	缺整齊
	0.3	77	113	20.96	156	11.93	124	12.3	85	
	0.5	76	112	20.63	154	11.72	122	12.4	85	
Blaes dust-2	0.2	88	129	18.40	137	11.34	118	12.0	83	較CK略遜
	0.3	83	122	18.10	135	11.16	116	11.0	76	
	0.5	77	113	17.47	130	10.76	112	11.0	76	
Blaes M dust	0.2	85	125	18.53	138	11.72	122	12.2	84	與CK略同
	0.3	80	118	18.51	138	11.61	121	12.3	85	
	0.5	81	119	18.46	130	11.24	117	11.5	79	
Spergon	0.2	89	131	14.91	111	10.86	112	13.2	91	整齊但生長較緩
	0.3	81	119	14.90	111	10.69	111	12.6	87	
	0.5	80	118	14.41	107	10.23	106	12.2	84	
CK		68	100	13.43	100	9.61	100	14.5	100	

註：*處理播種後，經10時之生長情形。

據表(三)所示，就藥劑之種類而論，在溫室環境下，盆栽試驗結果，則以 Semesan 之效果最爲良佳，Arasan, Spergon, Blaes M dust, Copper Sandoz, 等次之，Ceresan, Blaes dust-2, Riogen dust, Asozin dust-15, Granosan 0.2% 等又次之。其他各處理間之發芽情形，除 Granosan 0.3%, 0.5% 因藥害關係使其發芽率減低之外，均較無處理者爲優，而有增進種子發芽之效果。各處理間之生長情形，除 Granosan, Ceresan, Riogen dust, Asozin dusn-15 等因藥害關係凋萎者甚多，及 Riogen dust 0.2% 以外之處理根數均稍少之外，其餘芽長、根長等均較無處理者爲優。Spergon 增進種子發芽之效果雖佳，惟有生長較緩之趨向。

四、討　　論

綜觀室內及溫室內之結果，在本試驗所用10種藥劑中，Copper Sandoz, Blaes dust-2 等對白絹病病原菌菌絲生長之抑制效果較遜。Granosan, Ceresan, Riogen dust 等因用量較多，使菜豆種子發芽率減低，並招致多數凋萎者，而顯有藥害，惟 Granosan 似有發生瓦斯而使病原菌菌絲殆全停止伸長，氣中菌絲倒伏萎縮，將其毒死之現象，此有待將來之檢討。Asozin dust-15 對病原菌菌絲生長之抑制效果較差，同時因藥害關係招致多數凋萎者。上述數種藥劑之效果，就本試驗用量之範圍內，似無特殊之優點。其餘 Semesan, Arasan, Spergon, Blaes M dust 等4種，對抑制病原菌菌絲生長及增進種子發芽均有良佳效果，其中以 Semesan 爲最優，Arasan 次之，Spergon, Blaes M dust 之效果雖不如上列兩種，但其用量爲 0.2%時效果仍佳。至於就 Semesan 之用量而言，當以 0.3%較妥。

玆爲明瞭 Semesan 0.3% 在實際上應用時之防病效果及對種子發芽之影響，將按粉衣法拌種處理之種子播於內盛殺菌砂土之鉢盆，每盆播種子25顆，2盆爲一組，每顆種子近側，各置放培養病原菌經7日之小麥培養基1顆，蓋上薄土，另將上述培養病原菌之小麥培養基接種於殺菌砂土，經3日後播種，蓋土，使其發芽生長，經10日後調查其發病及發芽情形，試驗在溫室內施行，試驗進行期中室內晚間溫度爲 21.5°-27°C，日間溫度爲 26°-32.5°C，其結果如下：

表四、Semesan 0.3%之處理對菜豆白絹病之防除效果及對種子發芽之影響

Table 4. Effectiveness of seed treatment with Semesan(0.3%) on the seedling emergence and the controlling of southern blight of kidney bean.

處理 Treatment		發病種子 Seeds Infected		無發病種子 Seeds noninfected		發芽 Seedlings emerged		備考* Remarks
		百分率 Percentage (%)	指數 Index	百分率 Percentage (%)	指數 Index	百分率 Percentage (%)	指數 Index	
Semesan 0.3 %	a	56.67	61	43.33	465	59.33	371	16.00
	b	41.33	48	58.67	440	64.00	246	5.33
CK	a	93.33	100	9.33	100	16.00	100	6.77
	b	86.67	100	13.33	100	26.00	100	12.67

註：a播種時，同時接種病原菌者。　b接種病原菌，經3日後播種者。

* 發芽之後，子葉發病腐爛者之百分率

如上表所示，應用 Semesan 0.3% 處理種子，對抑制種子發病及增進種子發芽之效果均頗爲卓著，播種時同時接種病原菌者，其不發病率以無處理區爲100時，處理區爲465，其發芽率以無處理爲100時，處理區亦可至371，接種病原菌於砂土，經3日後播種者，其不發病率以無處理區爲100時，處理區爲440，其發芽率以無處理區爲100時，處理區亦可至246。

總之，在實際上應用時，當以 Semesan 0.3% 最爲可取。

五、摘　要

本試驗係於室內及溫室內，探討菜豆種子藥劑處理對白絹病病菌發育之抑制效果，及對種子發芽與生長之影響，其結果如下：

1. 供試藥劑中制菌效果最優者爲 Granosan, Ceresan，其次爲 Arasan, Semesan, Blaes M dust 等，Spergon, Riogen dust 等又次之，Copper Sandoz, Blaes dust-2, Asozin dust-15 等之抑制效果較遜。

2. 各藥劑處理對增進種子發芽及其生長，以 Semesan 之效果爲最著，Arasan, Spergon, Blaes M dust, Copper Sandoz 等次之，Blaes dust-2 又次之，Granosan, Ceresan, Riogen dust, Asozin dust-15 等之效果較劣。

3. 對病原菌發育之抑制及增進種子發芽與生長同時有效者，以 Semesan 爲最優，Arasan 次之，Spergon, Blaes M dust 等又次之。

4. 在實際上應用時，當以 Semesan 0.3% 最爲可取。

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THE EFFECT OF SOME FUNGICIDES ON SEED TREATMENT OF KIDNEY BEAN FOR CONTROL OF SOUTHERN BLIGHT

by

F. S. Wu

SUMMARY

The present paper deals with the results of a study on the effectiveness of certain dependable seed protectants which could be espected for control *Sclerotium rolfsii* Sacc., the causal fungus of southern blight of kidney bean, to promote the seedling emergence and seedling stand after treatment. The seed treatment was made in laboratory and in greenhouse. The summary of the results is exhibited as follows:

1. Fungitoxicity of the seed treated to the development of causal organism was conducted in laboratory. So far as the fungicides employed in the present experiments were concerned, Granosan and Ceresan were proved most effective, in addition, Arasan, Semesan and Blaes M dust were more fungitoxic than Spergon and Riogen dust, while Copper Sandoz, Blaes dust-2, Asozin dust-15 give poor protective effectiveness.

2. As to the seed germination tests conducted in greenhouse, Semesan was proved highly promoting the seedling emergence and seedling stand after seed treatment, in addition, Arasan, Spergon, Blaes M dust, Copper Sandoz were more effective than Blaes dust-2, while Granosan, Ceresan, Riogen dust and Asozin dust-15 were less effective.

3. So far as the experimental results obtained from laboratory and greenhouse trials were concerned, Semesan was proved most effective either inhibiting the development of causal organism or promoting the seedling emergence and seedling stand after treatment, in addition, Arasan was more effective than Spergon and Blaes M dust.

4. In practical used with Semesan, it is better to adopt to the dosage at 0.3% (Percentage of dosage is based on the weight of dry seeds).

TESTS WITH SOME INSECTICIDES AGAINST THE RICE STEM BORER, *CHILO SUPPRESSALIS*

by

SUNG-YANG LEE and WEN-YAU HONG

Damage by the rice stem borer, *Chilo suppressalis* Wlk., to paddy plants has recently become extremely serious in many localities throughout the Island, commanding urgent study of effective control measures. Tests to evaluate some old and newer insecticides for the control of the larvae were conducted during the growing seasons of 1962–3 at Taipei. This paper reports the results of these tests.

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MATERIALS AND DOSAGE

The paddy plants used in this work were variety Taichung No. 65. The larvae used were those hatched from the egg clusters collected in the field in Tainan district. Insecticides used were all in a form of emulsifiable concentrate, unless otherwise stated. The dosage was 6 cc. of 0.05% emulsions per hill (equivalent to 1,200 liters per hectare); and for BHC, 30 kg. of 6% dust per hectare, which was applied in irrigation water.

INITIAL TOXICITY

Four tests were conducted, three in 1962 and one in 1963. In test one, effect of parathion and endrin on one week-old larvae was investigated. Twenty test larvae were released per hill on May 1st on the plants planted in pots, 48 day-old after transplanting. Sprays were applied seven days after releasing the larvae, which were then mostly in the second instar, feeding in the outermost leaf sheaths that already changed yellowish in color from damage. The mortality of the insects was examined four days after trertment. The data are given in table 1. It appears from these data that parathion gives better control than endrin, and 0.05 per cent concentration seems to be more desirable than 0.03 per cent. In test two, the test larvae were released, 30 per hill, on the plants on June 11th, which were planted in field, 84 day-old after transplanting (about 10 days before heading). Sprays were applied seven days later. The results were examined four days after spraying. The data are shown in table 1. In this test only a small part of the test insects released was recovered in some treatments. Thus the comparative effect between different treatments was not quite clear. Nevertheless, Sevin did not seem to be promising for the control of the borers. In test three, the larvae were released, 22 per tiller, on October 4th and 5th on the plants transplanted in pots on August 12th. In order to standardize

Table 1. Initial toxicity of some insecticides against one week-old larvae of the rice stem borer feeding in the outermost leaf sheaths of paddy plants at different growing stages. 1962. Taipei.

Treatment and Concentration (%)	No. of Tillers Examined	No. of Insect in Conditions Shown			Mortality* (%)
		Live	Moribund	Dead	
Test one, May 1-11; plants, 48 day-old					
Untreated	24	11	0	0	0
Parathion 0.05	22	0	0	16	100
0.05	23	0	0	13	100
0.03	27	0	3	5	100
0.03	24	0	1	5	100
Endrin 0.05	26	3	0	6	67
0.05	29	0	0	5	100
Test two, June 11-12; plants, 84 day-old (about 10 days before heading)					
Untreated	26	7	0	0	0
Sevin w.p. 0.05	24	3	0	3	50
Sumithion 0.05	29	0	0	3	100
Lebaycid 0.05	20	0	2	14	100
Endrin 0.05	19	0	0	11	100
Dimecron 0.05	20	0	0	22	100
EPN 0.05	18	0	2	24	100
Parathion 0.05	15	0	2	14	100
Telodrin 0.05	17	0	3	9	100
Test three, October 4-12; Plants, 46 day-old					
Untreated	6	105	0	5	5
Sevin w.p. 0.05	6	82	0	23	22
Sumithion 0.05	6	0	0	118	100
Lebaycid 0.05	6	1	0	123	99
Endrin 0.05	6	19	0	109	85
Dimecron 0.05	6	0	0	93	100
EPN 0.05	6	0	0	106	100
Parathion 0.05	6	0	0	109	100
Telodrin 0.05	6	8	0	112	93
BHC 6% dust	6	45	0	40	47

*In counting per cent mortality, the moribund larvae were grouped with the dead ones.

the test plants as much as possible only 6 tillers were used in each hill; and their outer leaf sheaths damaged by leafhoppers or by wind were removed five days before releasing the test insects. Sprays were applied by an oil spray gun on Oct. 8th. The results were examined four days later. The data are summarized in table 1. Sevin again gave poor initial kill in this test. The effect of endrin was not satisfactory. Excellent control was obtained with Sumithion, Lebaycid, Dimecron, EPN, and parathion. Telodrin also showed promising results. BHC dust did not give good control in this case, in which little attention had been paid on supplying irrigation water

regularly after treatment. In test four, the effect of parathion and BHC dust was re-evaluated. The larvae (25 to 40 per hill) were released on June 7, 1963 on the plants planted in pots, 38 day-old after transplanting. Treatments were made two days after releasing the larvae. In BHC treatment, irrigation water was replenished every day during the course of the test. The results were examined 7 or 8 days after treatments. The data are shown in table 2.

Table 2. Initial toxicity of parathion and BHC dust on two day-old rice stem borer larvae. June, 1962. Taipei.

Age of Plants (days)	Treatment and Concentration (%)	Per Cent Mortality and (Total Number of Larvae Recovered)
38	Untreated	5(22)
	Parathion 0.05	72(18)
	BHC 6% dust	100(9)
78	Untreated	0(32)
	Parathion 0.05	53(40)
	BHC 6% cust	90(10)

The data of table 2 show that BHC dust when used under constantly irrigated conditions, gave better initial kill than parathion which was rather poor in this test. It is noteworthy that the effect of BHC dust is due to gamma BHC disolved in irrigation water which is translocated into the feeding site of the larvae by the three routes, i. e., root absorption, by penetrating into the straw in the irrigation water, and by penetrating into the leaf sheath above the water level (the toxicant moves up the straw by capillary action). Tests with the paddy borer larvae (data not given) clearly indicated that if BHC dust is applied in paddy field with no free water standing very poor kill of the larvae resulted.

RESIDUAL EFFECT

Six tests were conducted, four in 1962 and two in 1963. In tests one and two, effectiveness of endrin and parathion was investigated. Sprays were applied with a hand sprayer on May 19th, on the plants 59 day-old after transplanting. Twenty larvae per hill were released four days later in test one, and 40 per hill, five days later in test two. The damage to the straws and the mortality of the larvae were examined on May 31st. The data are given in table 3. The results in table 3 indicate clearly that poor residual control of the rice stem borer is obtained with endrin or parathion. In tests three and four, sprays were applied on Sept. 27th by an oil spray gun on the plants planted in pots, 51 day-old after transplanting (about 14 days before heading). To standardize the test plants as much as possible only six tillers, partly 5 tillers, of similar conditions in a hill were used, their loose outer leaf sheaths were removed five days before spraying. In test three, 20 larvae were released per tiller six days after spraying; in test four, 12 larvae per tiller were released 10 days after spraying. The damage to the leaf sheaths and to the ears was examined

Table 3. Residual effect of endrin and parathion against the newly hatched rice stem borer on paddy plants 59 day-old after transplanting. May, 1962. Taipei.

Treatment 0.05%	No. of Tillers Examind.	No. of Tillers Damaged	Per Cent Mortality of Larvae and (Total No. Recovered)
Test one, larvae released 4 days after spraying			
Untreated	35	4	0(11)
	48	5	0(14)
Endrin	46	6	7(14)
	43	9	0(12)
Parathion	50	7	14(7)
	56	6	0(7)
Test two, larvae released 5 days after spraying			
Untreated	46	11	4(27)
	47	11	0(26)
Endrin	41	9	24(17)
	51	10	6(18)
Parathion	52	10	6(33)
	37	6	0(24)

on Oct. 16th and 29th repectively. The results are shown in table 4, which show that EPN is the best treatment tested. Telodrin and endrin show some effect but other insectides were residually not reliable. Test five was conducted to re-evaluate the effect of parathion and BHC dust. The plants planted in pots were treated on June 7, 1963. In BHC treatment irrigation water was replenished every day. The larvae (15 to 30 per hill) were released 5, 9, 13 and 19 days after treatments. The results were examined four days after releasing the larvae. Table 5 summarizes the data.

Table 4. Residual toxicity of some insecticides against the newly hatched rice stem borer on the plants about 14 days before heading. Sept.-Oct., 1962. Taipei.

Treatment 0.05%	Per Cent of Leaf Sheaths Damaged		Per Cent of Ears Destroyed	
	(Test three)	(Test four)	(Test three)	(Test four)
Untreated	100	100	66	66
Sevin w. p.	100	100	100	66
Sumithion	100	100	100	50
Lebaycid	100	100	100	40
Endrin	66	50	100	0
Dimecron	100	100	100	50
EFN	0	0	0	0
Parathion	100	67	100	67
Telodrin	50	60	17	60
BHC 6% cust*	89	100	17	100

*Irrigation water not supplied regularly after treatment.

Table 5. Residual effect of parathion and BHC dust against the newly hatched rice stem borer larvae. June, 1963. Taipei.

Age of Plants When Treated (days)	Treatment and Concentration (%)	Per Cent Mortality of the Larvae and (Total No. Recovered) (larvae released at indicated days after spraying)			
		5	9	13	19
8	Untreated	0(9)	0(11)	0(9)	0(9)
	Parathion 0.05	36(14)	38(8)	17(6)	0(10)
	BHC 6% dust	67(9)	82(11)	100(14)	75(8)
36	Untreated	0(12)	0(25)	0(9)	0(12)
	Parathion 0.05	29(7)	0(13)	8(13)	0(8)
	BHC 6% dust	100(9)	88(16)	100(10)	44(9)
78	Untreated	0(6)	0(24)	0(11)	0(13)
	Parathion 0.05	0(8)	5(19)	10(21)	6(16)
	BHC 6% dust	100(7)	94(17)	87(15)	100(10)

The data in table 5 indicate clearly that BHC dust gives much better residual control than parathion at the dosages used, and the residual activity of parathion was surprisingly poor. In test six, effect of Imidan was compared with parathion and BHC dust. The plants, planted in pots, 43 days after transplanting, were treated on Oct. 12, 1963; and 17 larvae were released per hill 8 days later. The results were examined 11 days afte releasing the larvae. Table 6 shows the data, which indicate that residual activity of Imidan was not satisfactory, but was better than parathion.

Table 6. Residual effect of Imidan, parathion and BHC against the rice stem borer larvae, eight days after treatment. Oct., 1963. Taipei.

Treatment and Concentration (%)	Mortality of the Larvae and (Total Number Recovered)
Untreated	0(8)
Parathion 0.05	0(13)
BHC 6% dust	100(10)
Imidan e. c. 0.05	40(13)
Imidan w. p. 0.05	30(10)

SUMMARY

Trials were conducted to evaluate initial and residual toxicity of some insecticides against the larvae of the rice stem borer, *Chilo suppressalis*. In three tests, at the dosage of 0.05 per cent concentration per hill, Sumithion, parathion, EPN, Lebaycid, Dimecron, Telodrin, and BHC dust when used under constantly irrigated conditions gave excellent or good initial kill of the young larvae, but endrin and Sevin were not satisfactory. Parathion, however, was rather poor in one test. For residual effect, Sumithion, Dimecron and Lebaycid were poor; Telodrin, endrin Imidan and parathion were not reliable. EPN, and BHC dust when used with irrigation water constantly replenished were the best residual treatments tested.

二化螟虫之藥劑試驗

李淳陽　洪文堯

中文摘要

本試驗爲探討數種殺蟲劑對於二化螟 (*Chilo suppressalis*) 幼蟲之初效及殘效。在三個試驗中，以0.05%濃度，每欉 6c.c. 用量使用之 Sumithion, parathion, EPN, Lebaycid, Dimecron, Telodrin 及經常在灌漑情況下使用之 BHC 粉劑對於幼齡幼蟲有良好初效，但 endrin 及 Sevin 效力則不足。不過，parathion 在另外一次試驗中效果並不甚良好。殘效方面，Sevin, Sumithion, Dimecron 及 Ledaycid 效果不佳，Telodrin, endrin, Imidan 及 parathion 則不甚可靠，EPN 及在灌漑水經常補充之條件下施用之 BHC 粉劑均有優秀殘效。

文　獻　介　紹

ABSTRACTS OF LITERATURE

一、黑麥與麵包小麥之 Homoeologous group V. 之單染色體個體(monosomics)雜交所生具有二七及二八個染色體雜種之染色體配對及形態 [M. D. Upadhya & M. S. Swaminathan (1963) The Indian Jour. of Genetics and Plant Breeding 23 (3), 225~231]

爲檢定是否有與第Ⅴ羣相同的遺傳因子存在於其他兩個相似染色體對 (homoeologous partners)，將黑麥 (Secale Cerele) 雜交於缺第Ⅴ、第 IX 及第 XVIII 條染色體之單染色體 (Monosomics) 之中國小麥，在雜交後代中獲得 2n＝27 與 2n＝28之植物體。此二植物在外表上並無顯著之差別但其減數分裂情形大爲不同。在 mono－Ⅴ X Secale Cerele, 2n＝28 之 F_1 染色體之接合型爲 1Ⅱ＋26Ⅰ，2n＝27之F_1，則出現 Ⅳ、Ⅲ、Ⅱ 及單價染色體。在 mono－Ⅸ ×Secale cerele, 2n＝28之 F_1 表示 1Ⅱ ＋26Ⅰ之配對，2n＝27 之 F_1，則表示1個棒狀二價染色體(rod-shaped bivalent) 與 26 個單價染色體 (Univalent)。在 mono－XIII×Secale cerele, 2n＝28 之F_1 表示 1Ⅱ＋26Ⅰ 之配對，2n＝27 之 F_1 則表示 1Ⅱ、2Ⅱ、3Ⅱ 或 4Ⅱ 之配對。在 mono－X VIII×Secale cerele, 2n＝28 及 2n＝27 植物無芒而其他雜交組合有芒，即 mono Ⅴ 與 mono Ⅸ 之 2n＝27 植物均有芒，表示有一對或一對以上之芒抑制因子存在於第 Ⅴ 及第 IX 染色體上。穗頸有毛 (hairy neck) 向來被作爲黑麥×小麥雜交成功與否的一種指標 (marker)。在 2n＝28 之雜種上，穗頸有毛，但在 2n＝27 之雜種，並無此性狀出現。小穗梗與小穗花接處 (Rachis spikelet juncture) 短毛可在 (mono－Ⅴ及 mono－XVIII×Secale cerele 之 2n＝27與 2n＝28 二雜種內出現，但未出現在 mon－IX×Secale cerele 之 2n＝27 植物上。因此認爲支配小穗梗與小穗花連接處短毛之遺傳因子位在第 IX 條染色體上。本試驗認爲中國小麥抑制芒發育之遺傳因子同時座落於第Ⅴ及第 IX 及第 XⅧ 條染色體上。（謝順景）

二、水稻放射線誘發之小穗異常和突變 [P. Narahari & K. C. Bora (1963) The Indian Jour. of Genetics and Plant Breeding 23 (1), 7~18]

水稻因放射線照射而誘致形態上的改變，是一普遍的現象。現在更利用離子之照射，以造成水稻細胞遺傳學效用之誘變。在印度 Cuttack 中央水稻研究所 (Central Rice Research Institute) 選取栽培稻 GEB－24 (印度型)，農林6號、愛國(日本型)和 GEB－24×農林6號、GEB－24×愛國雜種第6代之乾燥去殼種子用不同程度之中子處理，調査其 N_1、N_2、N_3 處理後三代。N_2 選取單株做爲突變之研究，在 6,539 個體之族羣中，有 920 株對照品種和 176 個後代系統。除了部份的葉綠素致死和一株不稔外，發現有11突變體。

N_1 代內發現有：護頴伸長 (Elongation of sterile glume)、多殼 (Polyhusks)、簇粒(Clustered spikelets)小穗倒生(Inverted spikelets) 和缺少內(外)頴、外頴邊緣融合、內外頴不成比例的伸長及三個小蕊……等不正常的性狀。

在 N_2 及 N_3 代內則發現有：開頴 (Open spikelet)、谷粒先端尖細 (Tipped grain)、早熟和紫稻 (Early and purple mutant) 鑲嵌 (Chimera)、莖短和不倒伏 (Short-culmed and non-lodging plants)、捲葉 (Incurved lamina) 等不正常的性狀。

由護頴之伸長和多殼，可證明植物體內被

抑制的機構 (mechanism)，可因人工誘變而恢復原來之大小形狀。同時在此，發現長護頴和多穀性，倒生小穗，簇粒等，均爲不能遺傳。(按：此點與許多前人研究的結果完全相反)。

突變矮稻常伴有其他性狀之改變，如細粒，分蘖及葉數增多，穗數，葉長，着粒密度之減少。這些突變體，雖使產量減少但在農藝的觀點上，却有分蘖多，直立和不倒伏等之優點。(嚴盛添)

三、十種栽培稻和野生稻之深水生長習性 [H. Kihara, T. C. Katayama & K. Tsunewaki (1962) The Japanese Jour. of Genetics 37 (1), 1～9]

在熱帶和亞熱帶地區，耐水浸是稻的一種重要經濟性狀，可用來判定深水生長習性 (floating habit) 的能力。已知一部份亞洲栽培稻 (Oryza sativa) 和非洲栽培稻 (O. glaberrima)具有此特性。據 Morishima 等 (1960) 之報告 O. sativa 之近緣植物 O. perennis 亦具有此習性。

共用十個品系爲材料，栽植於木箱中，3重複，6處理 (即每天增加水深分0、1.5、3.1、4.6、6.2、9.3公分)。將木箱懸於深 3.5m 之蓄水庫中，然後每天依處理之情形漸漸放入水中。從試驗開始至結束共73天，記錄每個植株淹入水中之日數，並於結束時，量取株高，節間總長度，節間數目。用統計分析方法求F值，求 5%之最低顯著標準，其結果，節間總長可分三個明顯之集團卽O. sativa 中之2系統和 O. perennis 之1系統屬强性浮稻，O. perennis 中之 2系統和 O. glaberrima 之一種屬弱性浮稻。在所有强性浮稻中，株高和節間總長度有明顯的相關，而與葉長之關係較小。換句話說，株高之增加，是由於節間伸長之結果。弱性浮稻間差異較小，因此很明顯的，這些品系之深水生長習性，是一部份依靠葉的伸長，一部份依靠節間總長度之伸長。而浮稻節間總長度之增加，幾乎是靠節間數之增加和節間平均長度之伸長。此外，由原產地自然界所量得節間長度之比較下得知，自然情況下，水深之增加，是呈被動狀的，因此植物在生長之各時期，必須適當的伸長它的節間長度，以與自然環境配合。節間伸長的比例，在一定限度內，大部份與淹水速度成比例。(嚴盛添)

四、水稻顏色之遺傳 [R. D'Cruz & C. V. Dhulappanavar (1963) The Indian Jour. of Genetics and Plant Breeding 23 (1), 3～6]

水稻之遺傳，在日本和美國已引起普遍的興趣。Nagao (1951) Nagai (1959) 曾將日本研究者之結果做一摘要；Ramiah (1953), Ghost, Ghatge 和 Subramanyan (1960) 亦曾在印度將工作做一總檢討。但對連鎖研究的功勞，則尙未被大家所接受。Jodon (1948, 1955 和 1956) Nagao 和 Takahashi (1959) 曾試圖將所有的資料整理合併在一起。Jodon 所指出者，未超過八個連鎖羣，Nagao 和 Takahashi 則已有十二羣之記載，此數正與單元體染色體數相等。現在Kadam和D'Cruz (1960) Richharia, Misro, Butany Seetharaman (1960)，已研究出更多的連鎖資料。

利用 Kagisali-44-1：谷粒纖細 (fine grain)，有香味(Scent)、葉環 (junctura)、護頴和內外頴有色、柱頭、鞘葉無色。和 Antarsal-200：谷粒粗糙(Coarse grain)、只柱頭和鞘葉 (Coleoptile) 有色。雜交後，分別種植 F_1, F_2 和 F_3。觀察上述性狀之分離，並用積算法計算連鎖值。因子符號，採用國際稻米會議決定之符號。

結果 F_1 之鞘葉，護頴，內外頴，柱頭有色，Junctura 無色。在 F_2 各性狀分離情形觀察結果，各性狀均呈3：1之分離。鞘葉、護頴、內外頴和柱頭上，有色是顯性。葉環處則無色爲顯性。F_3 中，鞘葉、護頴、內外頴、柱頭色等有分離者，其 F_2 均爲有色。而 Junctura 色之分離則發生於 F_2 無色之個體。護頴與內外頴色間無交換値之發現，此可能是因子多種效應 (pleiotropic action) 或是兩因子之距離非常接近之故。而 Junctura 和護頴色間，連鎖値爲 40.45% (Repulsion) Junctura 和柱頭色間爲 46.56% (Coupling)。護頴和柱頭色間爲 8.21% (Repulsion)。

Junctura 無色呈顯性是初次發現，此可能受抑制因子(I_p)支配之結果。於是假定 A-200 親本 Junctura 色是受 I_{p} 之抑制作用，而 K-44-1 有色是受 i_p 之作用。而此處所求得之新連鎖羣 P_s-P_g-I_p，或許可加於 Nagao 和 Takahashi 之第5連鎖羣（紫色柱頭抑制因子）。（嚴盛添）

五、奇拔靈(Gibberllic acid)處理單因子突變矮玉米的生長反應[Bernard O. Phinney (1956) Proc. Nat. Sci., 42, 185～187]

一般都熟知奇拔靈對某些高等植物有顯著刺激莖葉生長之效。Brian 與 Hemming 的報告指出，生長緩慢的豌豆品種，對施用奇拔靈的反應較生長快的品種爲大，氏等又指出在蠶豆及法國豆的高及矮品種亦有類似的生長反應，提示這種反應可能受遺傳的控制。

本文係報告作者以其五個各受不同單隱性遺傳因子控制及一個由單顯性因子控制的矮生突變玉米，試驗其對施用奇拔靈的生長反應，結果爲；由單隱性因子控制的五個品種中，有四個品種有顯著的反應，在連續的施用奇拔靈後，其生長高度達到和正常品種一樣但如中途停止施用，又漸恢復矮生性，另外一個隱性的矮生品種只有很輕微的生長反應，至於顯性的矮生品種則毫無反應，進一步的試驗發現，生長反應的程度隨奇拔靈的施用量，而增加，而突變品種的生長反應大於正常品種者，由上述處理的六品種中，生長反應的表現各異。表示矮生性的原因係隨控制此一矮生性狀的遺傳因子而異。（何永安）

六、應用荷爾蒙及胚培養而獲得稀有的雜種組合 [A. S. Islam (1964) Nature 251 (4916), 320]

黃麻的圓果種 Corchorus capsularis 與長果種 C. olitorius 雜交，如以前者爲父本，可以成功的產生雜種植株，反之以後者爲父本則不成功。既在長果種（父本）×圓果種（母本）的雜交組合中，着果數少，所得種子發芽困難，因之作者進行以荷爾蒙處理及使用胚之摘出培養，試圖產生此一雜種後代。

使用的荷爾蒙爲 300ppm. 的 IAA，以羊毛脂法處理採粉後的小花梗，以促進着果率，在雜交的87株上，發現來自單爲結果產生的果實27個，內含萎縮種子，棄去不用，以自其餘果實中取出的55粒種子，經過消毒後，將胚取出，於無菌狀態下，培養於數種培養劑上，包括添加有 0.1% 酵母抽出液的 Nitsch 氏及 White氏的基本培養劑，及此兩種培養劑各加入 IAA, kinetin, Gibberellic acid. 結果以曾加有 IAA 及 Kinetin 各 0.05 ppm 的 White 氏培養劑，胚的成活率最高，在此培養劑上所得 10 個雜種幼苗，連同在其他培養劑上成活的共 15 株，其中有二株爲半白化苗(Semi-albino)，移植土壤中不久即告死亡，其餘亦在移植後，3–8 個月內先後死去。生長期最長達 8 個月的一株，頂端生有四葉，高度只有 12.6 公分，遠較其親本的 200–300 公分爲矮。此雜種植株在葉的長寬比方面，呈現父本的顯性作用。葉的鋸齒性狀則爲中間型，並着生少數花芽，但於開花前掉落。（何永安）

七、光度與溫度對秧苗光合率的影響 [D. P. Ormrod (1961) Agronomy Journal 53 (2), 93～95]

本研究係將水稻種子播於盆中，再將盆置於控制室內，使二氧化碳保持一定的濃度，再分別以不同的溫度與光度加以處理。溫度分40°F, 60°F 與 80°F 等三種；而光度則自 0 至8000 燭光。由試驗結果知：(1)一般而言 3½ 週的秧苗與5週的秧苗，其溫度與光度對光合率的相互作用很相似，而與苗齡無關。但在光照下，每增加一克乾物質，吸收 CO_2 量依苗齡的增加而減少；如以全植株而言，則依苗齡略爲增加。(2)在黑暗時期，秧苗呼吸作用排出的 CO_2 量依溫度之昇高而增加。(3)於强光度下，60°F 與 80°F 兩種處理，其 CO_2 的吸收量很相近，可是光度減弱時，80°F 下的秧苗，其吸收 CO_2 量有很顯著的減少。(4)對於 CO_2 的利用情形，在 40°F 下比 80°F 下要差；但依光度的減弱，40°F 下的秧苗，其 CO_2 吸收量之減少情形，要比在 80°F 下之秧苗緩慢得多。(5)經 40°F 的低溫處理後，置於高溫强光度下，對 CO_2 的吸收量比未處理者多。

由上述的試驗結果知道：40°F 的低溫對於水稻光合率並不特別有害，只是在低溫、弱光度下，光合作用的速度與呼吸作用受了影響，而有剩餘的 CO_2 產生。光合作用的確受光與溫度相互作用的影響，在 40°F 至 80°F 間，光比溫度有更大的影響力。短期間的低溫 (40°F)，對光合作用的影響並不像長期低溫那樣的嚴重；而長期的高溫與弱光度，由於呼吸作用較比旺盛，影響所及反而比低溫 (40°F) 弱光度來得嚴重。秧苗光合作用的補償點依溫度之昇高而需要更強的光度，即分別爲 40°F 與 150 燭光，60°F 與 400 燭光，80°F 與 1400 燭光。

無論是否在弱光度下，40°F 的低溫並不嚴重的影響光合率，或傷害光合作用機構。秧苗在不良的條件下，可能具有自其他方面獲得補償的功能。在低溫度下，包括生長在內的各種代謝作用與光合作用有很大的差異。健全秧苗的育成應同時考慮溫度與光度。（鄧耀宗）

八、環境與植物差異的聯合效應 [G. H.Freeman (1963) Biometrics 19 (2), 273～277]

環境的差異與植物特性間的關係是複雜的，植物顯現的特性爲環境差異與植物個體差異之和。一般田間試驗，我們常以區集來控制土異，而不考慮植物個體間的差異；蓋試區中有許多植株，以其平均值計算，可以不考慮植株間的差異。但如果樹作物，每試區中只有一棵，則個體上的差異將是十分重要。此外，試區面積之大小亦可能影響試驗結果。Fairfield Smith〔1938〕指出，由於大小不同的試區環境所引起變異間的關係是：$V'_x = V'_1/x^b$，V'_x 是指一試區 x 株中每一植株的變異，b 則介於 1 與 0 之間。如 b=0，暗指其差異不依靠試區的大小，若 b=1，則上述情勢減少，事實上是不容易達到兩極端的。更進一步的說，由試區中植物所引起的變異是 V''/x，假如植株以逢機方式種於田間，V'' 是指單一植株的變異。將兩項合在一起，以 V_x 表試區 x 株中每一植株的總變異，

則 $$V_x = \frac{V'_1}{x^b} + \frac{V''}{x} \cdots\cdots\cdots\cdots\cdots\cdots (A)$$

若以 $V'_1 = V_1\alpha$, $V'' = V_1(1-\alpha)$ 代入 (A) 式，而 α 是由單位試區環境變異所佔的比例，

則 $$\frac{V_x}{V_1} = \frac{\alpha}{x^b} + \frac{1-\alpha}{x} \cdots\cdots\cdots\cdots (A_\alpha)$$

試區間的變異關係已如式 (A) 所示，但相鄰植株間的連續相關關係亦得考慮。如以 ρ_1 表相鄰植株間相關關係，ρ_2 表隔一株間的相關，ρ_3 表隔二株間的相關，

則 $$V_2/V_1 = (1+\rho_1)/2$$
$$V_3/V_1 = (3+4\rho_1+2\rho_2)/9$$
$$V_4/V_1 = (2+3\rho_1+2\rho_2+\rho_3)/8$$
$$\alpha = 2\rho_1^2/(2\rho_2+\rho_3-\rho_1)$$

由上述方程式可得植株間的連續相關關係如下式：

$$\frac{(\rho_1+\rho_2)(\rho_1+2\rho_2)+\rho_3(2\rho_1+\rho_2)}{\rho_1^2} = \left(\frac{\rho_1+2\rho_2+\rho_3}{\rho_1}\right)^{1.585} \cdots\cdots\cdots\cdots (B)$$

因式 (B) 允許任何的 α 值，所以進一步的測驗是必要的。當 $\alpha=1$ 時，表示所有的變異都是屬於環境的。事實上當 b=1 時，α 值是無關緊要的。適當的假說可利用觀測值來測驗，由公式 (B) 所算得的 ρ_3（以 ρ_3'' 表之）與實測的 ρ_3 比較，假如式 (A_α) 不能成立，表示假說被推翻。於 α 值決定了之後，再看看是不是全像 $\alpha=1$ 之情形，或 Fairfield Smith 之情形，或着這數值是不可信的。

本研究以 1936——1942 年蘋果樹幹周長爲材料，分析結果，α 隨時間而自 0.04 增至 0.41，即環境的差異，由於土壤效應及根的競爭影響，隨着時間而增加其重要性，至少在最初幾年是如此。（鄧耀宗）

九、印度棉業 (Cotton in India) [B. L.Sethi (1961) 印度中央棉業委員會 (I. C. C. C.) 專刊]

印度乃產棉古國，本書係印度中央棉業委員會(I. C. C.C.) 之專刊，詳述印度研究棉業之成果，理論與實際並重。全書凡1486頁（八開本），分四巨卷刊行。執筆作者有 SETHI 博士，SIKKA 博士等卅一人之衆。每卷扉頁均有彩色棉株照片，代表印度四棉種。於1961年出版，爲亞洲唯一之棉業鉅著。內容新穎翔實，文字流暢，校對甚工，極少錯誤。於此亦可

窺見印度文化深遠獨到之處。

本書第一卷，着重概況與基本研究；而育種部份佔最多篇幅，約200頁。此卷計分八章，首五章述歷史，風土，分類，形態，與胚胎學。其中「分類學」之最末二節爲全書之綸節，扼要敍述歷來世界學者之研究結晶，對於棉作起源演化及分佈經過，已和盤托出。若不明瞭此綸節，將無從貫通全書各部份。

第一卷之後三章，分載育種細胞遺傳等資料。育種部份詳述棉作育種經過，目前51品種之農藝性狀與栽培季節均有記述。目前印度所着重之品種，多屬鷄脚棉與草棉之系統。因印度棉田94%不能灌溉，不得不種植耐旱之棉種。至於細胞遺傳部份，搜羅世界著名學者資料。對於我國學者所發表之花色遺傳模式亦有詳細引證。

第二卷詳述生理研究與農藝研究。生理研究中對於生長素之試驗頗有價值；次之，針對印度棉田單位面積內產量低落之原因，曾作多方研究。主要原因爲自然脫落率甚大，並且開花最盛期之同化作用不强。至於印度棉業之農藝研究着重肥料與灌溉，以期挽回地力衰退之趨勢。第二卷之末後三章，詳述病理蟲害與種子繁殖制度。

第三卷專述軋棉與貿易運銷，並述及纖維考查之專門技術綦詳。此卷對於棉商及廠家頗爲重要。論及脫粒方法時，從足搓以至輥軸機均有重要性。至於貿易與運銷之系統，在各棉區均有建立。貿易重心向在孟買市。此卷之末後三章，詳載歷年消費情形與進口出口統計。

第四卷爲印度棉業之分區記載，分旁遮普區，馬特拉區，（以上二區均有鷄脚棉與陸地棉）草棉區，鷄脚棉區，中部混植區，及東部區。其中最重要者爲鷄脚棉區與草棉區，乃印度棉業之精華所在。總計印度六個棉區之棉田面積，達一千七百萬至二千萬英畝，佔世界各國之首位。而產棉量爲五百萬包上下，佔世界各國中第四位。（孫貽謀）

十、低碘價紅花之遺傳 [Knowles, P. F. & Mutwakil, A. M. (1963) Economic Botany 17(2), 139～145]

自1950年至1961年間，在美國生產之紅花(*Carthamus tinctorius* L.)籽油，大部分被用於塗料工業。由於紅花籽油含有豐富的多價不飽和脂肪酸，已引起食品工業界的興趣，最近乃開始大規模地利用它。

紅花籽油的多價不飽和性是因籽油內所含的 Linoleic Acid 而賦與的。脂肪酸的飽和程度通常用碘價 (Iodine value) 測定之。美國現有商業品種之碘價在 138–145 之間，到目前爲止，尚未發現碘價較高的。現有品種之脂肪酸組成爲Linoleic Acid 76%, Oleic Acid 16%, Stearic acid 1% Palmitic Acid 7%，但最近曾發現遠較現有商業品種低碘價之型(type)其籽油的屈折率小，Linoleic Acid 含率低，而 Oleic Acid 含率反高。似此類組成之油脂可在其他現成的油脂中大量地發現而代替，故對此種紅花籽油之利用已不引人興趣。

作者等，爲研究低碘價紅花之遺傳情形，使用自印度引入之低碘價材料57–146或57–147（可能爲 Khan, A. R. 在1929年記載之New Pusa 29 及 30 號）與商業品種 N–10 及其他高碘價材料進行雜交，以所得的 F_1 用自交，F_2 用異花授粉來獲取其後代。在本研究，碘價之測定使用 Bausch & Lomb 公司的二種 refractometer。各雜交組合所得的結果，F_2 比率爲低碘價型 1，高碘價型 1，中間型 2（接近高碘價型），此表示 57–146 及 57–147 具有決定低碘價之主因子 *ol* 的存在，若種子的因子型爲 *ol ol*，而其碘價在 70–95 之間，則 *ol* 之相對因子 *Ol*（卽高碘價因子）在同質接合時，其碘價超過 131，若爲 *Ol ol* 時則碘價在 111–130 之間。

N–10 之脂肪酸組成爲 Linoleic Acid 76.2%，Oleic Acid 16%，Palmitic Acid 7.7%，而在 57–147 則各爲8.7%，86.8%，4.5%。調査 N–10 及 57–147 互相雜交所得的F_2種子（產生於F_1植株）之脂肪酸組成爲類似N–10，57–147，及中間型(接近於 N–10)的比率分別爲 1 ；1 ；2，其種子所具有的因子對籽油品質的影響較母株本身所具有者爲大。

紅花籽油的碘價變化是由於 Linoleic Acid 及 Oleic Acid之含率所致，而Palmitic Acid 的含量與 Linoleic Acid, Oleic Acid 無關。

來自印度的材料中比較常發現低碘價型，而此型之原產地認係在東部巴基斯坦的 Dacca 地區。（洪祖仁）

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JOURNAL OF TAIWAN AGRICULTURAL RESEARCH

CONTENTS

Studies on the Impact of Environment on the Characters of Seeds and the Subsequent Crop of the Rice Variety Chianung No. 242 .... W. L. CHANG...... 1

Effects of Split Application of Fertilizer and Planting Density on Yield, Components of Yield and Other Agronomic Characters of Rice .... W. L. CHANG & S. C. YANG......16

Report on Experiments about the Seeds' Size of Kinmen Early Kohlrabi .... P. N. LEE......28

Experiment on the Availability of PCP-Calcium Cyanamide for Paddy Rice and Its Effect on Weeding .... K. C. LIN, H. P. WEN & C. Y. WANG......32

The Effect of Some Fungicides on Seed Treatment of Kidney Bean for Control of Southern Blight .... F. S. WU......37

Tests with Some Insecticides Against the Rice Stem Borer, *Chilo suppressalis* .... S. Y. LEE & W. Y. HONG......44

ABSTRACTS OF LITERATURE 50

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